



**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON D.C. 20460**

August 29, 2002

OFFICE OF
THE ADMINISTRATOR
EPA SCIENCE ADVISORY BOARD

Note to the Reader:

The attached draft report is a draft report of the EPA Science Advisory Board (SAB). The draft is still undergoing final internal SAB review, however, in its present form, it represents the consensus position of the panel involved in the review. Once approved as final, the report will be transmitted to the EPA Administrator and will become available to the interested public as a final report.

This draft has been released for general information to members of the interested public and to EPA staff. This is consistent with the SAB policy of releasing draft materials only when the Committee involved is comfortable that the document is sufficiently complete to provide useful information to the reader. The reader should remember that this is an unapproved working draft and that the document should not be used to represent official EPA or SAB views or advice. Draft documents at this stage of the process often undergo significant revisions before the final version is approved and published.

The SAB is not soliciting comments on the advice contained herein. However, as a courtesy to the EPA Program Office which is the subject of the SAB review, we have asked them to respond to the issues listed below. Consistent with SAB policy on this matter, the SAB is not obligated to address any responses which it receives.

1. Has the Committee adequately responded to the questions posed in the Charge?
2. Are any statements or responses made in the draft unclear?
3. Are there any technical errors?

For further information or to respond to the questions above, please contact:

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MULTI-AGENCY RADIOLOGICAL LABORATORY ANALYTICAL PROTOCOLS (MARLAP) MANUAL: AN SAB ADVISORY

**REVIEW OF THE MARLAP
MANUAL AND APPENDICES
BY THE MARLAP REVIEW
PANEL OF THE RADIATION
ADVISORY COMMITTEE**

**WORKING DRAFT AUGUST 29, 2002
DO NOT CITE OR QUOTE**

Draft Dated August 29, 2002

EPA-SAB-RAC-03-0XX

The Honorable Christine Todd Whitman
Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW
Ariel Rios Building, Mail Code 1100
Washington, DC 20460

Dear Governor Whitman:

Subject: An SAB Review of the Multi-Agency Radiological Laboratory Analytical
Protocols (MARLAP) Manual

The MARLAP Review Panel of the Science Advisory Board's Radiation Advisory Committee met on April 8 (conference call), April 23-25, June 27 (conference call) and September 24-26, 2002 in Washington, DC to review the MARLAP Manual. In addition, the parent committee to the MARLAP Review Panel--the Radiation Advisory Committee (RAC)--met in earlier publicly advertised meetings to plan for the MARLAP review. In particular, MARLAP was introduced to the RAC at its August 1, 2000 meeting in Washington, DC. This was followed by a planning session at the RAC's December 13, 2000 meeting.

The MARLAP Manual was developed by a partnership among seven federal agencies, departments and commissions [the U.S. Environmental Protection Agency (EPA), the Department of Energy (DOE), the Department of Defense (DOD), the Nuclear Regulatory Commission (NRC), the National Institute of Standards and Technology (NIST), the U.S. Geological Survey (USGS), and the U.S. Food and Drug Administration (FDA)]. State participation in the development of the Manual involved contributions from representatives from the State of California and the Commonwealth of Kentucky. For the purpose of the RAC review, this group is termed the federal "MARLAP Work Group". The MARLAP Manual is intended to provide consistent guidance for laboratories and users of laboratory services in planning, implementation and assessment of projects entailing radioanalytical data and protocols.

We wish to bring to your attention that the partnership that produced this Manual represents the very best in practices by technical staff in government entities working together. Such collaboration brings collective wisdom and practical application of consistent and comprehensive science practices into harmony with a variety of regulatory and compliance practices in a way that deserves special recognition and kudos for common sense in government.

The MARLAP Review Panel found the Manual to be very well done and expects that it will be a valuable reference and especially helpful to analytical laboratories and users of laboratory services working with radioanalytical data and protocols. The primary recommendations from the Panel involve re-organization of the Manual to make it user friendly and easier for the intended audience to use. Through the EPA's Office of Radiation and Indoor Air (ORIA), the federal MARLAP Work Group posed three charge questions to the Panel regarding: 1) the effectiveness and clarity of the overall approach; 2) the technical accuracy of the

guidance on laboratory operations; and 3) the technical accuracy and clarity of the guidance on measurement statistics. The MARLAP Review Panel added a fourth charge question during a planning conference call pertaining to 4) overall integration and implementation issues.

With regard to Charge Question #1 (relating to the effectiveness and clarity of the overall approach), the Panel found that the performance-based and flexible approach in MARLAP is appropriate and, for the most part, presented clearly and logically in the draft MARLAP Manual. The Panel found the guidance provided with regard to a graded approach for projects of different scope, as well as the emphasis on data quality sufficient for the decision being supported, to be reasonable. The linkage of the planning, implementation, and assessment phases of projects involving radioanalytical data is effective. However, the Manual is massive and finding the information needed for a specific radioanalytical project may be difficult, especially for a first-time or infrequent user. In its attempt to make the various chapters stand alone, the MARLAP Work Group may have introduced excessive redundancy. The Panel had several specific suggestions for reorganizing and editing the document to improve its usefulness. Moreover, the document sometimes reveals its multiagency origins by sidestepping important areas where consensus was not possible.

With regard to Charge Question #2 (relating to the technical accuracy of the guidance), the Panel found that the document is an impressive compilation of information and recommendations that should be immensely useful to radiochemical analysis practitioners. The Panel found the guidance to be, on the whole, reliable and well thought out; however, as would be expected with such a large compendium of information, some technical inaccuracies and inconsistencies were identified. The Panel included the most important of these issues in the text of its Review Report and recommended some changes or additions to several of the chapters. The Panel also recommended some changes in organization to add clarity and usefulness to the document. The bulk of the Panel's specific concerns are addressed in an appendix to this report.

With regard to Charge Question #3 (regarding the guidance on measurement statistics), the Panel found that statistical issues were addressed very well in the MARLAP Manual but offered several suggestions for reorganization and clarification to enhance its value, specifically for laboratory directors and staff. In particular, the terminology used in the MARLAP Manual and the treatment of uncertainty propagation in measured values need some re-evaluation, and perhaps, revision.

The Panel offered some suggestions beyond the charge given by the federal MARLAP Work Group regarding integration and implementation of the Manual. Due to the complexity of the issues addressed in MARLAP, the Panel suggested that EPA undertake a program to train laboratory personnel and users of radioanalytical data in much the same manner as occurred for the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) activity. The Panel also recommended that the agencies, departments and commissions involved in developing MARLAP support professional education to generate a new generation of experts in radioanalytical techniques because the pool of such specialists appears to be aging and eroding.

The comments and recommendations offered by the Panel are intended to assist in improving a document that is already very comprehensive and thorough and should not be construed as criticism, but as suggestions to improve the usability and user-friendly aspects of an already superior product.

We appreciate the diligence and cooperative spirit in which this ambitious project has been undertaken. We look forward to your response, particularly to the items raised in this cover letter to you.

Sincerely,

Dr. William H. Glaze, Chair
EPA Science Advisory Board

Dr. Janet A. Johnson, Chair
Radiation Advisory Committee
and MARLAP Review Panel
EPA Science Advisory Board

NOTICE

This report has been written as part of the activities of the EPA Science Advisory Board, a public advisory group providing extramural scientific information and advice to the Administrator and other officials of the Environmental Protection Agency. The Board is structured to provide balanced, expert assessment of scientific matters related to problems facing the Agency. This report has not been reviewed for approval by the Agency and, hence, the contents of this report do not necessarily represent the views and policies of the Environmental Protection Agency, nor of other agencies in the Executive Branch of the Federal government, nor does mention of trade names or commercial products constitute a recommendation for use.

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ABSTRACT

The Multi-Agency Radiological Laboratory Analytical Protocols (MARLAP) Review Panel of the Radiation Advisory Committee (RAC) of the Science Advisory Board (SAB), has reviewed the draft MARLAP Manual dated August 2001 and concludes that this Manual represents the very best in practices by technical staff in government entities working together. Such collaboration brings collective wisdom and practical application of consistent and comprehensive science practices into harmony with a variety of regulatory and compliance practices in a way that deserves special recognition and kudos for common sense in government.

The MARLAP Review Panel found the Manual to be very well done and expects that it will be a valuable reference which should be especially helpful to analytical laboratories and users of laboratory services working with radioanalytical data and protocols. The document is massive and new users may have difficulty in finding the information they need. Therefore, the primary recommendations from the Panel involve reorganization of the Manual to make it easier for its intended audience to use. The federal MARLAP Work Group posed three charge questions to the Panel involving 1) effectiveness and clarity of the overall approach; 2) the technical accuracy of the guidance on laboratory operations; and 3) the technical accuracy and clarity of the guidance on measurement statistics. The Panel added a fourth charge question on overall integration and implementation issues. The technical and editorial comments and recommendations offered by the Panel are intended to assist in improving a document that is already very comprehensive and thorough and should not be construed as criticism, but as suggestions to improve the usability of an already superior product.

Key Words: Analytical Protocols, Protocol Assessment, Protocol Implementation, Protocol Manual, Radiological Analytical Protocols

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Science Advisory Board (SAB)
Multi-Agency Radiological Laboratory Analytical Protocols (MARLAP)
Review Panel
Radiation Advisory Committee (RAC)**

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1.0 EXECUTIVE SUMMARY

The MARLAP Manual was developed by a partnership among seven federal agencies, departments and commissions [the U.S. Environmental Protection Agency (EPA), the Department of Energy (DOE), the Department of Defense (DOD), the Nuclear Regulatory Commission (NRC), the National Institute of Standards and Technology (NIST), the U.S. Geological Survey (USGS), and the U.S. Food and Drug Administration (FDA)]. State participation in the development of the Manual involved contributions from representatives from the State of California and the Commonwealth of Kentucky. For the purpose of the RAC review, this group is termed the federal “MARLAP Work Group.” The MARLAP Manual is intended to provide consistent guidance for laboratories and users of laboratory services in planning, implementation and assessment of projects entailing radioanalytical data and protocols.

The MARLAP Review Panel finds that development of the MARLAP Manual is an excellent example of interagency cooperation in line with the successful collaboration that produced the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM). The partnership that produced the MARLAP Manual represents the very best in practices by technical staff in government entities working together. Such collaboration brings collective wisdom and practical application of consistent and comprehensive science practices into harmony with a variety of regulatory and compliance practices in a way that deserves special recognition and kudos for common sense in government. The multi-agency authorship of MARLAP and the apparent consensus on a single overall approach gives the reader confidence about the reliability of the guidance and the solid good sense that underlies it.

Through the EPA’s Office of Radiation and Indoor Air (ORIA), the federal MARLAP Work Group posed three charge questions to the MARLAP Review Panel regarding: 1) the effectiveness and clarity of the overall approach; 2) the technical accuracy of the guidance on laboratory operations; and 3) the technical accuracy and clarity of the guidance on measurement statistics.

With regard to Charge Question #1 (relating to the effectiveness and clarity of the overall approach), the Panel found that the performance-based and flexible approach in MARLAP is appropriate and, for the most part, presented clearly and logically in the draft MARLAP Manual. The Panel found the guidance provided with regard to a graded approach for projects of different scope, as well as the emphasis on data quality sufficient for the decision being supported, to be reasonable. The linkage of the planning, implementation, and assessment phases of projects involving radioanalytical data is effective. However, the Manual is massive and finding the information needed for a specific radioanalytical project may be difficult, especially for a first-time or infrequent user. In its attempt to make the various chapters stand alone, the MARLAP Work Group may have introduced excessive redundancy.

The Panel had several specific suggestions for reorganizing and editing the document to improve its usefulness. Above all, it emphasized the need for a thorough technical edit, the main objectives of which should be to (a) remove the considerable amount of redundancy, (b) ensure internal consistency among the chapters in presentation style and formatting, (c) make wider and more consistent use of effective techniques for presenting information, and (d) proofread all references, equations, tables, figures, and examples. To aid in this effort, the Panel noted several

460 presentation and formatting techniques in the Manual that it found to be particularly effective in
461 emphasizing important points.

462
463 The Panel also recommended the inclusion of more examples to illustrate the planning
464 process and the graded approach, so as to bring these to life for the reader. A variety of clearly
465 presented and realistic scenarios will be critical to the success of MARLAP and should emphasize
466 the potential benefits of planning and using a graded approach. The Panel recognizes that
467 policies are often implied in the assumptions that are adopted as part of the planning process, and
468 that it is difficult for a multi-agency document to address this non-technical aspect. The Panel
469 also recognizes the concern of the federal MARLAP Work Group that case studies or scenarios
470 could be interpreted by some users as setting or endorsing a precedent. However, the Panel
471 recommends that this concern be addressed up-front and not be used as an excuse to not present
472 realistic or complex case studies or scenarios in the Manual.

473
474 With regard to Charge Question #2 (relating to the technical accuracy of the guidance),
475 the Panel found that the document is an impressive compilation of information and
476 recommendations that should be immensely useful to radiochemical analysis practitioners. The
477 Panel found the guidance to be, on the whole, reliable and well thought out; however, as would be
478 expected with such a large compendium of information, some technical inaccuracies and
479 inconsistencies were identified. The Panel included the most important of these issues in the text
480 of its Review Report and recommended some changes or additions to several of the chapters. The
481 Panel also recommended some changes in organization to add clarity and usefulness to the
482 document. The bulk of the Panel's specific concerns are addressed in an appendix to its report.

483
484 With regard to Charge Question #3 (regarding the guidance on measurement statistics),
485 the Panel found that statistical issues were addressed very well in the MARLAP Manual but
486 offered several suggestions for reorganization and clarification to enhance its value, specifically
487 for laboratory directors and staff. In particular, the terminology used in the MARLAP Manual
488 and the treatment of uncertainty propagation in measured values need some re-evaluation, and
489 perhaps, revision.

490
491 In general, the Panel emphasized that its comments and recommendations are intended to
492 assist in improving a document that is already very comprehensive and thorough and should not
493 be construed as criticism, but as suggestions to improve the usability and user-friendly aspects of
494 an already superior product.

495
496 The Panel offered some suggestions beyond the charge given by the federal MARLAP
497 Work Group regarding integration and implementation of the Manual. Some of the main issues
498 with MARLAP do not concern the content but the ease of its use as a practical tool. The
499 implementation of radiochemical analyses is often driven by the requirements of existing
500 methods, set as standards by different organizations. Until these methods are revised, and
501 commitments from the authoring organizations are obtained, the radiochemistry community may
502 be in conflict over the application of MARLAP guidance.

503
504 Due to the complexity of the issues addressed in MARLAP, the Panel suggested that EPA
505 undertake a program to train laboratory personnel and users of radioanalytical data in much the
506 same manner as occurred for the MARSSIM activity. The Panel also recommended that the
507 agencies, departments and commissions involved in developing MARLAP support professional

508 education to generate a new generation of experts in radioanalytical techniques because the pool
509 of such specialists appears to be aging and eroding.
510

2. INTRODUCTION AND CHARGE

The EPA's Office of Radiation and Indoor Air (ORIA) requested that the Radiation Advisory Committee (RAC) of the Science Advisory Board (SAB) review the Multi-Agency Radiological Laboratory Protocols Manual (MARLAP). The RAC review was initiated in August 2000 while the MARLAP was still under development. The draft Manual was made available to the RAC in September 2001. The RAC review was completed in September 2002. Appendix A describes the details of the RAC review schedule and process.

2.1 Background About the MARLAP Manual

The MARLAP Manual provides "guidance for the planning, implementation, and assessment of projects that require the laboratory analysis of radionuclides." The intent of the Manual is to "provide the guidance necessary for national consistency in the form of a performance-based approach for meeting a project's data requirements" and to help "ensure the generation of radioanalytical data of known quality, appropriate for its intended use." The MARLAP is a performance-based system and is not intended to be a "cookbook." The Manual contains guidance but not specific laboratory procedures.

The MARLAP Work Group that developed the Manual consists of representatives of the Environmental Protection Agency (EPA), Department of Defense (DOD), Department of Energy (DOE), Nuclear Regulatory Commission (NRC), National Institute of Standards and Technology (NIST), U.S. Geological Survey (USGS), U.S. Food and Drug Administration (FDA), the Commonwealth of Kentucky, and the State of California.

2.2 Charge Questions

The specific charge questions posed by ORIA were as follows:

Charge Question 1: Is the overall approach present in Part I of MARLAP for the planning, implementation and assessment phases of projects which require analysis for radionuclides technically acceptable?

1a. Is the performance-based approach presented clearly and logically?

1b. Is the approach reasonable in terms of ease of implementation?

1c. Does the approach effectively link the three phases (planning, implementation, assessment) of a project?

Charge Question 2: Is the guidance on laboratory operations in the Part II chapters technically accurate? Does it provide a useful resource base of information for a laboratory's implementation of a performance-based approach?

Charge Question 3: Is the guidance on measurement statistics - specifically measurement uncertainty and detection and quantification capability - technically accurate, clearly presented, and useful for implementation by appropriately trained personnel?

2.3 RAC Review Process

The MARLAP was introduced to the RAC at its August 1, 2000 meeting in Washington, DC. The Manual was still in early draft form at that time and was not available for the RAC to look at, beyond the Table of Contents. The RAC determined that additional expertise would be needed for the review. Consequently, several consultants were added to the Panel to assist in addressing the organizational aspects of the Manual as well as its radiochemical and statistical issues. Three of these consultants joined the RAC for a planning session at its December 13, 2000 meeting. The Panel was divided into three subcommittees, and each subcommittee was assigned the task of responding to one of the three charge questions posed by ORIA. Most of the Panel members received the MARLAP document for review in September 2001. However, several members who were added to the Panel after the initial meetings did not receive copies of the document until March 2002.

A planning conference call (non-FACA meeting) was held with the subcommittee chairs on February 4, 2002, at which time the three charge questions were discussed and a fourth charge question was added. A pre-meeting conference call with the entire Panel was conducted on April 8, 2002. Panel members submitted preliminary (pre-meeting) comments prior to the Panel meeting in Washington DC on April 23 - 25, 2002.

Members of the federal MARLAP Work Group (who were responsible for the Manual's content) met with the Panel on April 23, 2002 and presented general information on the content of the Manual. The Work Group answered questions posed by the Panel members. The Subcommittees then met separately with members of the MARLAP Work Group joining them for further discussions centering on the specific charge questions in the course of the balance of the meeting (April 23-25, 2002).

During the April 23-25, 2002 public meeting, the Subcommittee addressing the overall approach, i.e., responding to Charge Question #1, employed a tool that is unique to this review, at least for the RAC. In order to get a sense of how a laboratory manager or other critical users might perceive MARLAP, the Subcommittee engaged in a role-playing exercise with members of the MARLAP Work Group. This exercise was very enlightening, particularly in identifying and clarifying areas where MARLAP may be confusing and/or not a practical guide for the user.

The MARLAP Review Panel met on September 24-26, 2002 in a second face-to-face meeting to review, edit and its first public draft report dated August 29, 2002 and to reach closure on the topic..(continue).....

The cooperative process between the Panel and the MARLAP Work Group proved to be very useful. It facilitated the flow of information from the Work Group to the Panel as well as providing an opportunity for the Work Group to hear and understand the concerns of the Panel. Questions that might have been posed in the Panel's draft Review Report were addressed at the time they were raised, thus saving much effort and reducing the need for later corrections. The RAC very much appreciates the time and effort the federal MARLAP Work Group devoted to explaining aspects of the Manual and the rationale behind its organization. While the subcommittees worked in close cooperation with the Work Group, that process did not compromise the independence of the peer review.

2.4 Report Organization

Responses to specific charge questions are contained in Sections 2, 3, and 4 of this report. In addition to responding to the specific charge questions, the Panel addressed several issues that went beyond the charge. These issues are presented in Section 5. Section 6 summarizes the Panel's most important recommendations. Appendix C to this report includes specific technical comments that relate to the need for more precise or succinct wording, additional detail in the guidance, corrected references, cross-referencing, and clarification of statements or terminology used in the Manual.

Detailed editorial comments provided by Panel members were transmitted under separate cover from the SAB Staff to the ORIA Staff (See References Cited: Kooyoomjian. 2002. To Dr. Mary E. Clark). Names of subcommittee chairs and members, and a list of the MARLAP Manual chapters and appendices assigned to each subcommittee, are included in Appendix A of this report.

3. RESPONSE TO CHARGE QUESTION #1: TECHNICAL ACCEPTABILITY, PRESENTATION, EASE OF IMPLEMENTING THE PLANNING, IMPLEMENTATION AND ASSESSMENT PHASES

Charge Question #1: Is the overall approach presented in Part 1 of MARLAP for the planning, implementation and assessment phases of projects which require analysis for radionuclides technically acceptable?

1a. Is the performance-based approach presented clearly and logically?

1b. Is the approach reasonable in terms of ease of implementation?

1c. Does the approach effectively link the three phases (planning, implementation, assessment) of a project?

3.1 Overall Response to Charge Question #1

Compiling and organizing information and guidance related to the acquisition and use of radioanalytical analyses was a formidable but worthy task to be undertaken by a multi-agency committee. The committee was largely successful in achieving its goal of developing a consensus document on this complex topic. Overall, the MARLAP Manual is a very impressive document with almost encyclopedic amounts of useful information. Chapters 1-9 are well prepared and thoughtfully organized, making this document very useful for persons needing to obtain or provide radioanalytical services for large-scale projects. Finally, the multi-agency authorship of MARLAP and the apparent consensus on a single overall approach gives the reader confidence about the reliability of the guidance and the solid good sense that underlies it.

3.1.1 Response to Charge Question #1a

With only a few reservations about explaining the context in which MARLAP will operate, the performance-based and flexible approach is appropriate and presented clearly and logically in the draft document. The exposition is better than in most EPA documents at this stage of review.

3.1.2 Response to Charge Question #1b

Although some of the guidance in MARLAP may stretch the capabilities of those who must plan, manage, and conduct radiochemical analyses (see detailed discussion in Sections 2.2 and 2.3), the approach is reasonable, especially in light of the graded approach for projects of different scope and importance, and the emphasis on data of quality sufficient for the decision being supported rather than on specific requirements for analytical procedures or data precision and accuracy.

3.1.3 Response to Charge Question #1c.

The linkage of the planning, implementation, and assessment phases is largely effective as well. However, the Panel recommends that MARLAP provide guidance or recommendations to the end user who receives the analytical data that are generated through MARLAP, with regard to traceability, compilation and archiving of the data. For certain types of projects the assembled data may be useful in the future in the context of a different project. However, such data will only

be useful if they are compiled and stored with sufficient information regarding sampling location, method, sampling time, analytical procedure etc. Inclusion of a statement regarding this issue could be very beneficial to project planners and managers.

3.2 Detailed Comments on Organization and Presentation of Part I

The following comments are offered in the hope of further improvement, not as a criticism of this important effort. The comments are classified into the following categories: organization, presentation style, technical aspects, terminology, formula, examples of the process, and issues outside our scope.

3.2.1 Organization

The organization of the draft MARLAP document is complicated, and it is not obvious how the user should make use of this thick two-volume manual. The present draft is wordy, with information being scattered and repetitive. The goal of producing stand-alone chapters is ineffective in practice because this repetition is distracting to those who are reading more than one chapter at a time, with the result that the reader very quickly loses interest. The following suggestions are made to address these shortcomings:

1. The goal should be to make Part I a stand-alone volume, replacing the goal of stand-alone chapters. The Panel envisions Part I as including the information presented in Chapters 1-9 and Appendices A-E.
2. Chapters should be thinned down and focused. Information in the chapters should be limited to that which the majority of users are likely to need to know, with the reader being referred to an appendix or references for extended discussions of exceptions, alternative options, or less common aspects.
3. In order to improve usability and to reduce repetition, we suggest that Appendix B be melded into Chapter 2. Instead of discussing all planning process options, the main body of the Manual should stick with one model (Data Quality Objectives) and discuss the alternatives only in an appendix.
4. Problems associated with navigating efficiently through the document could be minimized through the use of a decision tree to guide the user to sections that are relevant to a particular issue.
5. Navigation through the document could also be made easier through the use of hyperlinks in a computerized version of MARLAP.
6. In general, the document eventually answers almost every question that occurs to the reader while reading it. However, it is so extensive that questions that arise in one section may be answered only in another section well removed from it. Although the document has extensive cross-referencing, it could do even better in that regard. Some examples are provided in our specific comments in Appendix C.
7. The utility of the Manual would benefit from the inclusion of an index.

3.2.2 Presentation Style

During one of the Panel's subcommittee sessions, a member of the federal MARLAP Work Group observed that the emphasis of key points and redundancy were already built into the document, but that key points were nonetheless still being overlooked by new readers. Why is that the case? In its role as new readers, the Panel felt that the presentation style was often ineffective, and that it took too long for the reader to "catch on" and to "see the big picture." The following suggestions are made to address that problem.

1. A well-written Executive Summary could provide a means to unify MARLAP by using clear, simple text and figures to show the linkages among the chapters without the distracting repetition that is currently present. The Executive Summary should make use of figures and tables in the place of extensive text, as appropriate, to summarize sequential steps and interrelationships.
2. Acronyms are likely to be a major stumbling block at first for most readers. Although training and time may make some readers more comfortable with use of acronyms, the document is acronym-heavy and plain language should be used more often.
3. A good overview figure is needed at the outset, a figure that lays out the entire planning process and shows the interrelationships among the steps. Figure 1 in this report is provided as one attempt to produce such a figure (Refer to Figure 1 at the end of Section 3).
4. Figures and tables should be designed so as to reinforce the text, or to help reduce the need for lengthy discussions. For example, Figure 1.1 is particularly helpful in presenting the concept of a Data Life Cycle without a lot of words. In many cases, however, the flow charts and other illustrations or tables are not always particularly useful and are sometimes even confusing, with the important ideas covered better in the text. For example, the text seems to be quite repetitive of the information given in Table 3.1 without giving any added value. In these cases, the authors or technical editor should consider deleting one or the other. As an aside, the Panel noted that the text used in the flow charts is too small in many cases and unreadable in a few cases.
5. The MARLAP text is clear about the very non-linear and iterative nature of the planning process, even at its first step. However, this aspect is not reinforced by the figures and tables. Figures 1.2 and 1.3 are static and linear; these figures should include feedback loops to more clearly convey the sense of the process of continual reassessing and fine-tuning the objectives and approaches.
6. The Manual's table of contents indicates that a glossary will be provided. As this is being done, it may be useful to place terms in bold font in each definition to indicate that they are further defined in the glossary.

3.2.3 Technical Edit

In order to make the Manual more user-friendly, efficient and effective, it should receive a thorough technical edit. The main objectives of this edit should be to remove the considerable amount of redundancy, ensure internal consistency among the chapters in presentation style and formatting, and make wider and more consistent use of effective techniques for presenting information. The Panel found the following presentation and formatting techniques to be particularly effective in emphasizing important points:

1. The boxed Summaries of Recommendations at the end of Chapters 2-7 and 9 are useful and easy to understand. However, the number of recommendations for some chapters appears to be too few relative to the large amount of detail given in that chapter (or vice versa). Suggestions for additional recommendations are provided in Appendix C of this report.
2. The clear inclusion of an "Output" statement at the end of the discussion of each Analytical Planning Issue (MARLAP Section 3.3) is very helpful in understanding the value and importance of each item discussed.
3. The checklist format used in some of the chapters is particularly noteworthy as an effective way to organize and communicate information. In addition to the specification of inputs and explicit outputs for key analytical issues in MARLAP Section 3.3, Chapters 7 and 18 also employed well-designed checklist formats. Section 7.4.2.2, which addresses on-site audits, is effective in telling the reader what to look for. This approach is equally useful for the laboratory and the client in that it identifies for both parties the key aspects to be examined during an audit and thus facilitates communication between them about expectations. Similarly, the chapter on Laboratory Quality Control (Chapter 18) provides succinct lists of potential causes for specific types of analytical problems, which is an effective way to convey some of the lessons learned from many years of practical experience by the MARLAP co-authors.
4. Section 8.5 guides the reader through the data verification and validation process by spelling out the criteria to be met, and the approach to first verify, and then validate, that the data meet the specified criteria. MARLAP is unusual among guidance documents on laboratory data acquisition insofar as it clearly distinguishes the differences in the issues to be identified and resolved in the data validation and verification steps.
5. The format used in Chapter 18 subsections is particularly user-friendly: first defining and summarizing the importance of the issue at hand, then expanding on its subtleties in a more extended discussion, briefly mentioning excursions as appropriate, and finally ending with specific examples.

Reference citations in the document are particularly problematic in the draft document, for being incomplete, inconsistent, and sometimes outdated. Regulations cited in the text should be included in the list of chapter references so that the reader can judge their potential applicability to specific situations. For example, U.S. Department of Transportation (DOT) regulations may not be applicable to material transport on roads that are closed to public access, such as is

commonly the case for some of the DOE laboratories. To the extent possible, cited references should refer to current editions.

Finally, the Panel notes that all tables, equations, and figures throughout the Manual require careful proofreading.

3.3 Detailed Comments on Technical Content of Part I

3.3.1 Technical Issues

No significant technical errors were found during the Panel's review. However, the Panel recommends that the MARLAP Work Group consider addressing the following points, at least in a cursory fashion, in the Manual.

1. It is evident that the structured MARLAP approach may not work well for novel analyses to serve novel situations. For example, it probably would not be very helpful in deciding whether some innovative approach to analyzing a short-lived and volatile radionuclide is reliable. MARLAP should not be expected to cover every situation; it might be useful for the Manual to state more clearly and directly to what types of decisions it applies. As an example, the Panel refers the MARLAP Work Group to Table 1.1, Scope of MARSSIM, in MARSSIM (2000).
2. The document makes it clear that the radioanalytical specialist is essential throughout the planning, implementation, and assessment phases. However, the skill set for this position differs from that for the generic "radiation physicist" as described in most job specifications. It thus may be useful for MARLAP to include a sample job specification or Statement of Work (SOW) that could be used by small licensees or small regulatory programs to hire a radioanalytical specialist to help with writing a project-specific SOW, evaluating the bids, and assessing the data. In addition, the document should note areas in which individuals with related backgrounds could also conduct some of the tasks.
3. As a practical problem, there is no guidance for what action should be taken if no one bids on the SOW for a project.
4. The document is unclear with respect to its relationship with the National Environmental Laboratory Accreditation Conference (NELAC).
5. The Panel agrees with the approach taken by the authors to seek and identify points on which consensus could be reached, such as an overall approach (or structure or framework) to be taken rather than details on the specific steps or the order in which they should be taken. Nonetheless, it would be useful for users if the Manual openly acknowledged that many areas exist in which agency guidance or requirements are currently not uniform or consistent, such as in the establishment of action levels, reporting uncertainties, assessment of penalties assessed if specifications are not met by the contracted laboratory, differences in number of significant figures reported, attention given to estimating yields, and treatment of negative data.

6. There is a need to check generalizations that may not apply to a significant proportion of the target audience or to the samples with which they may be dealing, and to assess whether exceptions to these generalizations are sufficiently important to warrant at least a brief mention. Several examples are given in Chapter 11. Guidance on line 207 of page 11-8 is to treat contaminated packing material and packages as radioactive waste; however the possibility that there may be non-radioactive hazardous contaminants that would require the contaminated material to be classified as mixed waste is not mentioned. Similarly, page 11-6 seems to mandate a designated receiving location for all samples, and page 11-14 states that sample storage areas must be posted as Radioactive Materials storage areas. For small projects or those limited to the analysis of very low levels of radioactivity, these apparent “mandates” may not be applicable or may even be counter-productive (e.g., by storing low-level samples together with high-level samples). Page 11-4 (lines 73-75) states that laboratory facilities that handle radioactive materials are required to have a radioactive materials license issued by the NRC or the Agreement State in which the laboratory operates, with the exception of certain DOE national laboratories and DOD laboratories. However, it is important to make clear that the latter facilities themselves cannot handle unrestricted levels of radioactive materials. They operate under similar types of regulation-driven restrictions as other laboratories, that are administered internally.

3.3.2 Use of Examples

More examples are needed to illustrate the planning process and the graded approach, so as to bring these to life for the reader. A variety of clearly presented and realistic scenarios will be critical to the success of MARLAP and should emphasize the potential benefits of planning and using a graded approach. The Panel suggests the following for adding more examples:

1. References to good examples of process outputs (e.g., Statements of Work) from different agencies would be helpful. Specific examples or case studies would also be helpful, such as how to analyze a volumetrically-contaminated sample (e.g., scrap metal) in order to decide its disposition. Specific scenarios or case studies could be carried through each chapter to illustrate and contrast how a particular step would be implemented in those particular cases.

2. The MARLAP process appears to be designed for, and is applicable to, large projects encompassing a team and a relatively large number of samples. However, it is not clear that it would be practical to implement for small projects. Although the document refers to a graded approach, very little guidance is provided for small projects. The detailed process described in the MARLAP Manual requires intensive use of resources. This is appropriate for large-scale environmental projects but not for small-scale evaluations and other activities. Therefore, it would be useful if the Manual could advise users on circumstances for which a much simpler approach would be appropriate. The limited number of references to a “graded approach” (e.g., p. 2-4, lines 103-109, Section 4.5.3, and the first recommendation on p. 4-18) do not provide guidance that is clear or complete.

3. The federal MARLAP Work Group should consider whether a simpler version of MARLAP could be prepared, that would be applicable to the \$10,000 to \$50,000 projects that involve taking no more than 10 to 20 samples and that cover a small area. This is an important point. It is clear that regulatory agencies may try to force the entire MARLAP process on situations and organizations for which it is not appropriate. The unfortunate reason is that most regulators are reluctant to make any judgments on their own. Some “out” must be available for small projects that are being forced to respond to trivial radiological situations. All of us have seen examples where some fraction of the public does not want a project to proceed for non-radiological reasons. Yet, the radiological flag is raised in the belief that this is issue more effective than other reasons for not wanting a project. Suppose, for example, an entity had a small site with the potential for very low levels of contamination. This type of project could be a short-term project, involving probably one health physicist and a construction team. The health physicist would be responsible for site safety as well as the development of the sampling and analysis plan and production of the final report. The entire budget could be expended in writing the Project Plans described in MARLAP. Can a simpler outline be developed that would give reasonable assurance that the DQOs would be met but without the myriad of written plans and reviews? A limited version of MARLAP could cover the development of DQOs, sampling and analysis plans, and verification and validation of data but would not necessarily go into great detail in the selection and evaluation of a laboratory. Contract laboratories can be selected just on the basis of past experience.

4. The Panel recognizes that policies are often implied in the assumptions that are adopted as part of the planning process, and that it is difficult for a multi-agency document to address this non-technical aspect. The Panel also recognizes the concern of the federal MARLAP Work Group that case studies or scenarios could be interpreted by some users as setting or endorsing a precedent. However, the Panel recommends that this concern be addressed up-front and not be used as an excuse to not present realistic or complex case studies or scenarios in the Manual.

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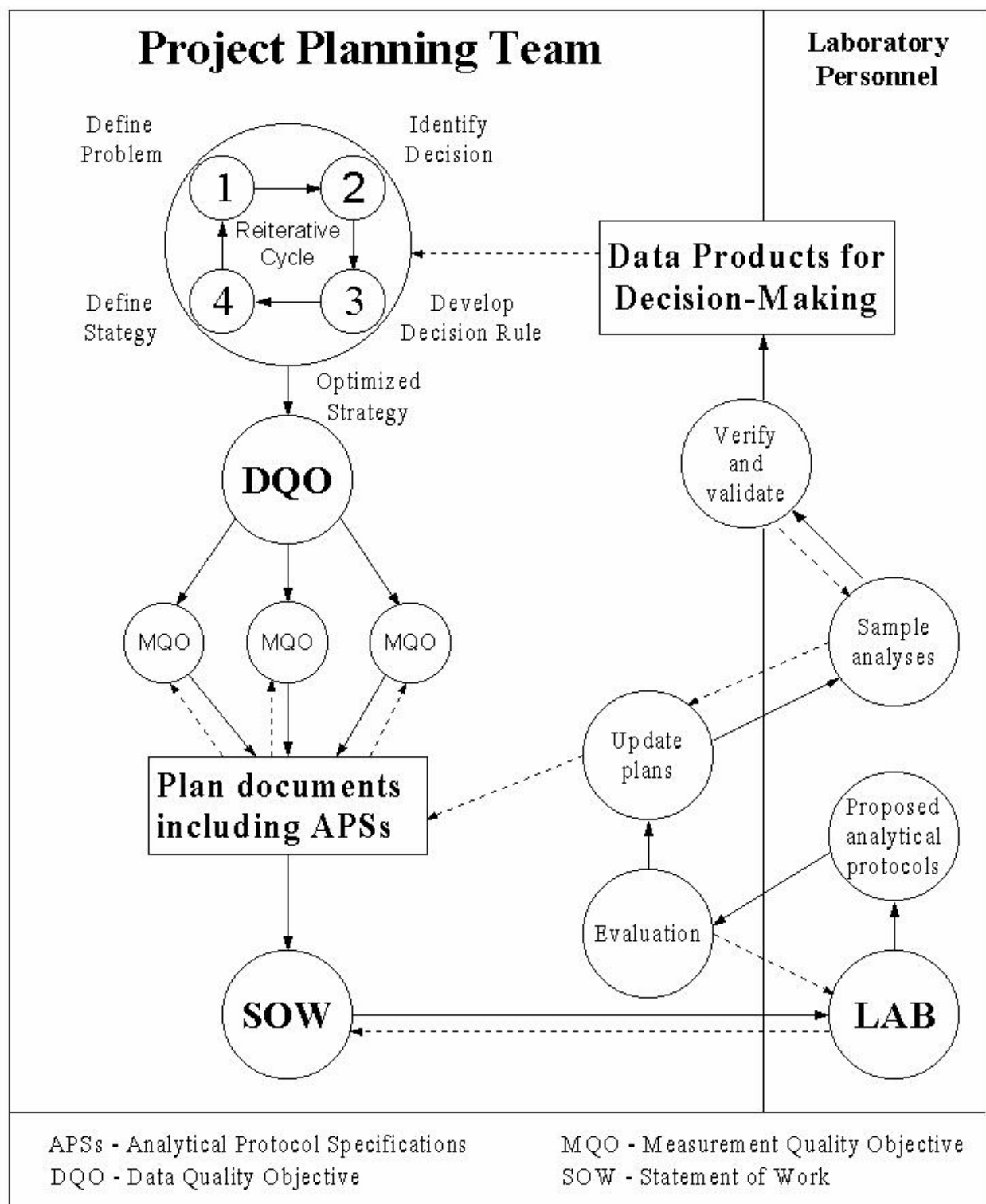


Figure1. Schematic of the MARLAP planning, assessment and implementation process. Solid arrows indicate advancement to next step, while dotted arrows indicate feedback loops to an earlier step.

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4. RESPONSE TO CHARGE QUESTION #2: TECHNICAL ACCURACY OF GUIDANCE ON LABORATORY OPERATIONS

Charge Question #2: Is the guidance on laboratory operations in the Part II chapters technically accurate? Does it provide a useful resource base of information for a laboratory's implementation of a performance-based approach?

4.1 Overall Response to Charge Question #2

MARLAP is an impressive compilation of information and recommendations that should be immensely useful to radiochemical analysis practitioners. The document addresses the entire reach of radiochemical analysis from project design to final report of results. Each section appears to have been prepared by competent specialists in the topic, and little appears to have been ignored or misinterpreted. The MARLAP document matches the MARSSIM document for providing guidance for the analyses of samples collected under the MARSSIM approach.

The following discussion focuses on Chapters 10 to 20 (excluding Chapter 19) and Appendix E of Part II because they specifically discuss the actual laboratory operations of analytical processing and measurement. Because these chapters are integrated into the entire text, some comments refer to related aspects in other chapters. On the whole, guidance in these chapters is reliable and well thought out. However, as would be expected for such a large document, the Panel found numerous errors. While many of the errors are typographical, they can be misleading, such as errors involving a chemical formula or technical terminology. Suggested corrections are compiled in Appendix C of this report.

The document is an encyclopedic resource. Chapters 10, 11, 12, 16, 18 and 20 are particularly well written, technically straightforward and very useful. For the sake of clarity, Chapters 13 and 15 require more important revisions because some of the information is either incomplete, not useful or repetitious. Most of the suggested changes are organizational or editorial in nature, although they affect the technical clarity of the document and its internal consistency. The following specific parts would benefit from revisions:

Chapter 13. Improve the presentation of information in Section 13.6 "Special Matrix Considerations" and Section 13.7 "Total Dissolution and Leaching". The current text in these sections is sometimes too general and other times very specific with direct quotes from published papers. Some information is either incomplete or not useful. Much of the discussion should probably be deleted, with the reader referred to specific publications for each special matrix.

Chapter 14. Improve the presentation of information in Section 14.10 by renumbering its subsections. Replace current title of Section 14.10 "Radiochemical Equilibrium" with "Analysis of Specific Radionuclides." Rename Subsection 14.10.1 "Introduction" and convert current subsections 14.10.1 to 14.10.8 into sub-subsections under new Section 14.10.1. Renumber existing sub-subsections under the current Section 14.10.9, which deals with specific radionuclides, as Sections 14.10.2 to 14.10.9.

In Section 14.10, cite the original reference for a method when the method is discussed instead of combining all references to be listed at the end of the subsection. In Section 14.10.9, delete descriptions of minerals and metals related to the radionuclide of interest in the many instances when these descriptions do not assist the analyst and can be obtained from readily available references. Also delete comments on the toxicity or hazard of a radionuclide except when advising on sample handling; if the reference to toxicity is intended to explain the purpose or required sensitivity of analysis, refer the reader to a radiation protection text.

Chapter 15. Revise the order of presentation in Chapter 15 and rewrite it. The chapter was confusing and/or repetitive because it is, in part, an ASTM text (D3648-95, *Standard Practice for the Measurement of Radioactivity*) that the Manual presents in reversed order.

Chapter 16. Integrate Chapter 16 with Chapters 12 to 15 by inserting suitable cross-references in these preceding chapters to the pertinent discussions in Chapter 16.

The Panel concluded that the performance-based approach for the MARLAP document is appropriate and presented clearly and logically. The linkage of the planning, implementation and assessment phases is important and well emphasized. The Panel suggests some reorganization of the presentation to the user, as described in recommendations provided in this review. Subject to the caveats listed in this section, Part II of the MARLAP document provides a much needed resource base for laboratory operations, and the Manual does a thorough job of explaining how decision-makers should make choices in the selection of hypotheses that help determine the confidence levels associated with the results obtained from analytical laboratories.

The Panel suggests that guidance on reporting environmental radionuclide data should depend on the end use of the data and the necessary transmission of information to the reader. Specifically, care should be taken to report radionuclide concentrations even when they are negative due to subtraction of radionuclide background, or when they are below the minimum detection level (MDL) as determined from counting statistics. Such numbers should be reported and used in compiling or averaging results and for evaluating the reliability of measurements near the limits of detection. For use in describing environmental radioactivity to the public, such numbers should be replaced by "less-than" values or a statement of non-detectability. Depending on the level of knowledge of facility operators and regulators, negative and zero values may or may not be appropriately replaced by the non-detect or less-than notation in reports intended for their use.

Some of the main issues with MARLAP do not concern the content but the ease of its use as a practical tool. The implementation of radiochemical analyses is often driven by the requirements of existing methods, set as standards by different organizations. Until these methods are revised, and commitments from the authoring organizations are obtained, the radiochemistry community may be in conflict over the application of MARLAP guidance.

The quality of the guidance on laboratory operations can be much more sensitive to the largely subjective choices of the decision-makers than to the nuances of the laboratory process. The Panel therefore emphasizes that it is crucial that the guidance to these decision-makers be as precise and directed as possible, to avoid the misuse of this process. The Panel strongly supports the initiation and maintenance of a teaching program and the implementation of a web site for this purpose. For example, there are questions about the guidance on recommending physically

impossible, negative values, when they are obtained analytically. Although there are clear advantages associated with transparency of reporting results, this solution may also lead to some confusion when comparing these data to other sets from existing standard analytical protocols. The Panel also recommends that the guidance on the omission or inclusion of data be more specific.

The MARLAP Manual should emphasize the identification and treatment of critical data. Analyses that influence the overall performance results should be evaluated and, when possible, redone prior to the completion of the decision process. Similarly, this point could also apply to the selection of the null hypothesis. This issue needs to be addressed in more detail in MARLAP. The most conservative approach may not be the correct one. Failure to thoroughly evaluate the null hypothesis in the early stages of a project may lead to the wrong policy decisions, i.e., that a relatively “benign” site requires remediation. This and other aspects of technical implementation of MARLAP’s performance-based approach will be greatly improved by user feedback as the document is tested through time.

4.2 Detailed Comments on Organization and Presentation of Part II

The Panel suggests that Part II be divided into two parts to facilitate convenient use in the laboratory. A reasonable separation may be between Chapters 10 to 14 and Chapters 15 to 20. Chapters 10 to 14 pertain primarily to chemistry. Chapters 15 to 18 address radiation detection issues. Chapter 19 on statistical considerations is a stand-alone chapter. Dividing Part II into two parts would make the document more convenient for use by radiochemistry and radiation detection and quantification users. Such a division would also help with the current unwieldy physical size of the document in its present form, and in locating the needed information more quickly by the users. This suggested logical division is described in more detail below.

Part IIa. Chapters 10 to 14. These chapters contain information on sampling considerations, sample receipt and inspection on laboratory premises, sample preparation and pre-treatment, and various separation techniques. All these topics are related and are likely to be used mainly by the radiochemistry laboratory staff (except possibly Chapter 10, Field and Sampling Issues).

Part IIb Chapters 15 to 20. The remainder of the document, i.e., Chapters 15 to 20, includes information on nuclear counting, instrumentation, calibration and test sources, data acquisition and reporting, quality control, statistical considerations, and waste management. These topics are somewhat related (except Chapter 19, which is a stand-alone chapter) and are likely to be used mainly by the counting laboratory staff.

Appendices should be rearranged for inclusion with the respective volumes, so as to facilitate the ease of use. Presently, all appendices for Parts I and II are placed at the end of Part II.

4.3 Detailed Comments on Technical Content of Part II

Note: Additional technical comments related to these chapters are compiled in Appendix C.

4.3.1 Chapter 10: Field and Sampling Issues That Affect Laboratory Measurement

Overall this chapter is straightforward and useful. In general, although not necessarily a bad thing, a disproportionate amount of space is devoted to radon. It is all good information, but invites the question why there are not analogous sections such as “Selecting Tritium Sampling Methods Based on Data Quality Objectives” or for any other radionuclide as well? A table summarizing the known problems related to container and type of acid for the various radionuclides, matrices, and analytical methods would be a useful addition to Chapter 10. For example, USGS documents usually indicate hydrochloric acid rather than nitric acid as a preservative for water. Is there a good reason for this? [Note: These sampling concerns could logically be addressed in either Sections 10.3.3.1 or 14.10.9.]

Several instances are noted in which the compilation of sampling methods or sampling data needs is incomplete:

Section 10.4.1. The Manual should remind users that the laboratory needs to document the amount of vegetative material removed from a sample so that environmental concentrations can be estimated appropriately for the exposure scenario(s) of interest. Also, sampling soil profiles and sediment cores for determining total inventory is an important technique that is not presented in this section of MARLAP. For example: soil at specified depths can be removed and analyzed separately. The activity vs. depth can be plotted, and the activity integrated over a particular depth of soil can be determined (c.f., Environmental Measurements Laboratory manual).

Section 10.4.2.1. This section implies total reliance on models for description of initial mixing and transport dispersion of radionuclides discharged to water. The use of dyes or other tracers in studies of complex situations should be acknowledged.

Section 10.4.3.2. In selecting foods and locations for food sampling, it is tempting to limit consideration of consumption habits to those of European-descended populations. The consumption and lifestyle habits of native peoples and other ethnic minorities can be quite different. MARLAP should recommend consideration of these differences. The use of inedible plants and non-game species as indicator organisms should also be mentioned in this section.

Section 10.5.4.2. Noble gases in air have also been collected for laboratory analysis by compressing air into SCBA tanks, by collecting in impermeable plastic bladders (e.g., Tedlar) for later compression, or by cryogenic methods. Radon isotopes do not present an issue as interferences if laboratory analysis is delayed sufficiently for their decay.

Section 10.5.4.3. Electrets can also be used for monitoring tritium at relatively high levels. The use of electrets was discussed with regard to radon so a discussion of that technology in the tritium section would also be appropriate (e.g., Surette and Wood, 1993). Although mentioned earlier, the molecular sieve technique is not identified as a method for collecting tritium. Molecular sieves are being used increasingly because of favorable properties such as less water

retention following bakeout and better collection properties in environments with fluctuating temperatures.

Section 10.5.5.2. Methods for measuring radon flux should be discussed in this section. In addition, Rn-220 analysis methods should be addressed.

Section 10.6.2. It would be very useful to indicate or reference suitable combinations of liquid scintillation fluids (cocktails) and filters for the liquid scintillation method of wipe testing.

The Panel also notes an exception to the general guidance provided on labeling of samples submitted to analytical laboratories. Section 10.2.4, lines 173-176, states the following: *“The project manager needs to determine if a sample number scheme may introduce bias into the analysis process. That is, the lab may be aware of trends or locations from the sample identification and this could influence their judgment as to the anticipated result and thereby introduce actions on the part of lab personnel that they would not otherwise take.”* This recommendation is short-sighted and implies that laboratories are not trustworthy. In particular, laboratories need to be aware of “hot” samples because they may use separate areas and or labware for processing. In fact in Section 12.2.2, lines 146-148, it is suggested that knowledge of historical or field screening data is useful to laboratories in preventing cross-contamination. In Section 12.2.4, lines 313-314 it is stated that: *“Operations should be segregated according to activity level. Separate equipment and facilities should be used for elevated and low_level samples whenever possible.”*

Some technical inaccuracies in guidance or in generalizations were noted in this chapter:

Page 10-8, lines 217-219. The time to date of analysis is usually captured in pre-established holding times, not left to the judgement of field sampling personnel who make entries in the log or on the data form.

Page 10-21, lines 660-661. *“...radionuclides that are highly insoluble, such as isotopes of uranium, thorium, and plutonium...”* This is an invalid premise. Uranium is somewhat soluble and occurs dissolved in some groundwaters. Thorium and plutonium are better described as relatively immobile in the environment rather than insoluble, because thorium nitrate, for example, is certainly soluble.

Page 10-24, line 766. The statement *“...paper pulp has been shown to remove more than 95 percent of radionuclides from solution...”* seems too general. Tritium, for example, would not likely be removed by paper pulp.

Page 10-27, line 839. The following sentence is much too simplistic as guidance for selecting milk sampling sites: *“Raw milk should be obtained from the closest cows or goats downwind from a source.”* For example, background sites should also be selected, and processed milk may have to be collected to fully characterize the impact on the general public. Significant iodine releases are much more likely to result from accidental exposures, which may be short term, than from continuous routine releases. Relying on a single “downwind” sampling location could potentially result in underestimating the impact of an episodic event.

4.3.2 Chapter 11: Sample Receipt, Inspection and Tracking

The relationships among various recommended documentation (e.g., bench sheets, laboratory logbook, "separate paperwork obtained before sample receipt," and "documents listing requests for specific analyses") need to be made clear. Good examples of these documents would be useful.

4.3.3 Chapter 12: Laboratory Sample Preparation

Overall, this chapter is straightforward and useful. Note that tritium may also be a problem for cross-contamination if low-level measurements are made in an environment where higher-level tritium sources are analyzed or in use. Tritium from leaking exit signs may also be a problem in certain laboratories. Similarly, the laboratory may have background levels of radon progeny from or natural sources in soil or possibly in its construction materials may create a problem in low-level counting laboratories. Radon decay products can become attached to surfaces particularly where a static charge may have been induced.

4.3.4 Chapter 13: Sample Dissolution.

In general, this chapter should be reorganized so as to discuss the issues from the simplest to the most complex. In addition, pages 13-26 to 13-33 are not well-written and will require extensive editing. The text in these sections is either too general or very specific with direct quotes from published papers. Some information is either incomplete or not useful. Also, the style is not consistent. This part should be deleted or presented differently. One approach would be to refer the reader to a specific publication(s) for each special matrix.

4.3.5 Chapter 14: Separation Techniques

A table summarizing the characteristics of alpha, beta and gamma radiation should be inserted at the beginning of Section 14.2 to illustrate that the extent of radiochemical separation is impacted, in part, by the type of radionuclide emission. An example of such a table is given below and relates directly to the understanding of the required chemical separation for each type of emission.

This chapter would benefit from some reorganization and revised headings. Section 14.10 should be titled "Analysis of Specific Radionuclides", which is its subject, rather than "Radiochemical Equilibrium", which does not describe its contents. Current sections 14.10.1 to 14.10.8 should be placed as subheadings in a new section 14.10.1 called "Introduction" or "Overview". Thus, current sections 14.10.9.1 to 14.10.9.12 become 14.10.2 to 14.10.13. To new section 14.10.1, add a brief explanation concerning the selection of the specific radionuclides that follow. The selection makes sense but should be justified.

Table 1. General Characteristics of Alpha, Beta and Gamma Radiation

Characteristic	Alpha Particles	Beta Particles	Gamma Radiation (Photons)
Identity	Helium nuclei	Electrons	High-energy electromagnetic radiation (e.g., gamma or x-rays)
Mass (g)	$\sim 10^{-24}$	$\sim 10^{-28}$	0
Charge	2+	1-	0
Typical distance traveled in water	Tens of : m	mm to cm	meters
Penetrating Power (relative)	1	100	10,000
Energy characteristic (initial emission energy)	Discrete	Continuous or discrete	Discrete
Required radiochemical separation	Extensive	Modest	Minimal or not required

The detailed descriptions of certain aspects of chemical behavior in current Sections 14.10.1 to 14.10.8 should be referred to in the specific radionuclide sections to avoid repetition concerning matters such as hydrolysis and polymerization. For specific radionuclides, extensive paragraphs that describe the occurrence, properties, and preparation of minerals and the metallic state should be deleted. Unless they are pertinent to the purpose at hand, a reader can look for these descriptions where the author obtained them. In a large tome such as this, the authors should limit themselves to pertinent information. The authors should reevaluate use of qualitative judgements of amounts of specific radionuclides, their toxicity, and the difficulty of analysis (examples are discussed below). The MARLAP document may somewhere have quantitative information or make reference to such information concerning amounts, doses and costs that could be used to place amounts and effects in perspective. A section on a specific radionuclide usually is consulted by a user in order to select or evaluate an analytical method. The contents will be most useful if each brief description is paired with the reference to the detailed description. The current practice of first describing all methods and then bunching the references at the end is not helpful.

4.3.6 Chapter 15: Nuclear Counting Instrumentation

This chapter seems to be at least two versions coupled together: (a) 15.2 to 15.6 and (b) 15.7 to 15.10. Much of the material in the first part is repeated in the second part. This chapter is admirably concise. However, it (especially 15.2 to 15.7) is not consistent with the rest of MARLAP, which is very detailed. The material in Chapter 15 would be more efficiently presented if it were to describe proportional counters and scintillation counters (or even each of the various types of detectors) first and then describe specific radiation types. This re-ordering of material would avoid the need to repeat the description for each type of radiation.

Section 15.7 is redundant with much of the early material but is written more in the style of the rest of MARLAP. This section answers many of the questions raised in reading the earlier sections. It might be worthwhile for the earlier sections to be merged into 15.7. Perhaps much of the overlap and difference in presentation in this chapter could be overcome by reorganizing the

chapter. Starting on page 15-26, the chapter reads very well. This section should be used as a guideline for the earlier parts of the chapter. Pages 15-31 and 32 are redundant with Chapter 16 and should be deleted. On page 15-39, the writing suddenly becomes very specific and prescriptive. Consider whether some of the material in Attachment 15A, "Field Measurements," is redundant with other chapters on calibration or quality assurance.

4.3.7 Chapter 16: Instrument Calibration and Test Source Preparation

Chapter 16 seems to be straightforward and unambiguous with a good balance between the general performance and the prescriptive. There are numerous reference citations. Some of the instrument descriptions in this chapter are better than the ones in Chapter 15. There are a number of instances with overlap with other chapters; however, this repetition probably cannot be avoided.

Chapter 16 deals with two topics, instrument calibration and test source preparation. Because instrument calibration is intimately linked to Nuclear Counting Instrumentation (Chapter 15), the question arises as to whether this topic should be included in Chapter 15 instead of Chapter 16. In contrast, test source preparation deals with converting the collected and processed samples to a suitable form for introduction to the counting instrument; hence, this topic is the bridge to Chapter 15 from:

- a) Chapter 12, Laboratory Sample Preparation (for samples that need minimal preparation),
- b) Chapter 13, Sample Dissolution (for samples that need moderate preparation), and
- c) Chapter 14, Separation Techniques (for samples that need radiochemical preparation).

The Panel suggests that the MARLAP Work Group consider making Test Source Preparation a separate chapter either before or following the current Chapter 15. The common thread between the two parts of Chapter 16 (instrument calibration and test source preparation) is that both the test samples and the calibration samples should be prepared in the same, consistent manner. These two topics could be separated, with a note in the test source preparation chapter that samples need to be consistent for the calibration to apply to all the samples. A note could also be inserted in the calibration section stating that the calibration sources need to simulate the geometry and composition of the test samples. The chapter as written flows well and it currently uses some of the material already introduced in Chapter 15. At a minimum, the document should be reviewed to ensure that the wording in Chapters 12, 13, and 14 and at the beginning of the Test Sample Preparation part of Chapter 16 recognizes and facilitates the linkages described above.

It is not clear what the role for commercial, plated alpha and beta sources is, particularly for alpha spectrometry. MARLAP should discuss the considerations, cautions, correction factors, etc. should a laboratory choose to purchase commercial sources rather than custom making sources from calibrated solutions.

Chapter 16 addresses standard reference materials (usually solution standards) which are used to make up instrument calibration standards. Also important are the matrix-specific reference materials that are used to check for recoveries from various matrices and to monitor for matrix-specific effects in sample preparation, dissolution, and separation. The MARLAP should address this issue. Two widely-used suppliers of standard reference materials are the National

Institute of Standards and Technology (NIST) and the International Atomic Energy Agency (IAEA). Examples of the materials available from these agencies include:

NIST: Environmental Natural Matrix Standards – various analyzed samples of soils, sediments, human tissue, and shellfish

IAEA: AQCS Reference Materials for the Determination of Radionuclides

a) Biological Materials of Marine Origin – fish and shellfish

b) Biological Materials of Terrestrial Origin – milk and dairy products, grass, other vegetation, bone

c) Non-biological Materials of Marine Origin – sediments, and

d) Non-biological Materials of Terrestrial Origin – soil and lake sediments

4.3.8 Chapter 17: Data Acquisition, Reduction and Reporting

In general, the text is very well written, with the exception of some repetitions and redundancies and editorial points as listed in Appendix C of this report. The Panel compliments the authors on the thorough technical job done for this chapter.

One shortcoming is that the advice to laboratories on how to check their own data is not adequate (Chapter 7.3 and 7.4 and tie-in of Chapter 17 with Chapters 8 and 9). MARLAP presents consumer advice on how to verify and validate data, but provides no parallel advice to laboratories on how to check their own data. Verification is possible but not validation. MARLAP should provide advice on data verification by the laboratory as well as by the consumer.

4.3.9 Chapter 18: Laboratory Quality Control

This chapter was very well written and the presentation of the material was very accessible. The Panel compliments the authors for the thorough technical presentations in this chapter.

The greatest problem resides in the presentation of the references in the text, which should be accompanied by a date of publication to distinguish these from earlier versions of the same documents. The reference section needs work and the format needs to be consistent throughout the section as well as throughout the MARLAP document (i.e., from chapter to chapter).

Attachments 18A and 18B are very useful additions to Section 18.3.2, “Statistical Means of Evaluating Performance Indicators_Control Charts.” Attachment 18A serves as a guide to the various control charts and their use in the statistical evaluation of data sets. The solutions to the problems given in the section should be verified using an internal QA procedure for all statistical and numerical problems and equations throughout the MARLAP document. The only problem noted in Attachment 18B is the equation indexing. Problems and their solutions are well presented and the section is very useful as an illustration of additional statistical methods available to the user of control charts.

NOTE: The Panel’s comments on **Chapter 19** are addressed under Charge Question #3 in Section 4 of this report.

4.3.10 Chapter 20: Waste Management in a Radioanalytical Laboratory

The chapter has good flow and is well written. The second paragraph in the introduction is a nice road map that tells what the chapter is all about. The chapter, out of necessity, gives general guidelines and then lists specific references to lead readers to more detailed information. Section 20.8, "Useful Web Sites," is an excellent addition to the chapter. However, just before final publication someone should verify that these sites are all still correct and active.

5. RESPONSE TO CHARGE QUESTION #3: GUIDANCE ON MEASUREMENT STATISTICS

Charge Question #3: Is the guidance on measurement statistics - specifically measurement uncertainty and detection and quantification capability - technically accurate, clearly presented, and useful for implementation by appropriately trained personnel?

5.1 Overall Response to Charge Question #3

The Panel agrees that the issue of measurement statistics was addressed very well but could benefit from some revision in specific areas (described below) to enhance its value to laboratory directors and staff. Review comments on Chapter 19 and Appendices C and G have been divided into four areas: organization, terminology, technical issues, and use of examples. The comments that follow represent a consensus on issues addressed by the Panel members.

5.2 Detailed Comments on Organization and Presentation of Chapter 19

5.2.1 Organization

Overall the Panel found that too much material was included in Chapter 19, and that the material is not presented in the most logical order. The Panel suggests several changes to address these problems:

1. Divide the chapter into two sections: (a) measurement, detection and quantification, and (b) uncertainty evaluation and expression.
2. Consider moving Chapter 18 (process control) to Chapter 20.
3. Provide the most important material at the beginning of the chapter. For example, there is a good discussion of counting statistics starting on page 19-44. This discussion should moved to (or near to) the start of Chapter 19.
4. Appendix E contains some good examples. These examples should be brought into the body of the text in appropriate places.
5. Number the examples to avoid duplication and facilitate reference in the text. For example, the example on page 19-121 is an exact duplicate of the one on page 19-69.
6. Bullet the important points in boxes. The box on the top of page 19-25 is a good example. It is, however, critical that these boxed "important points" be as clear as possible. For example, the box on 19-25 states: "A measurement result should not be compared to the minimum detectable concentration to make an analyte detection decision. A detection decision may be made by comparing the gross signal, net signal, or measured analyte concentration to its corresponding critical value." This important recommendation should also be illustrated at this point by an example.
7. Eliminate Attachment 19B, "Multicomponent Analyses."

5.2.2 Terminology

The Panel found the technical presentation to be statistically sound but too complex for the target audience of laboratory directors and staff. This chapter and several of the attachments

would be more understandable to non-statisticians if an attempt were made to use more colloquial language for presentations of concepts that will be easier to understand by the target audience. For example, the presentation of statistical independence vs. correlation provided on page 19-5, lines 122-127, is unnecessarily complicated and probably not needed. Similarly, Attachment 19C on coverage factors should either be deleted or revised. As currently written, it is doubtful that anyone without a Ph.D. in statistics and with experience in laboratory uncertainty analysis could implement this methodology.

Many of the terms used in the measurement statistics chapter may be commonly employed in the jargon of laboratory science, but these terms are confusing when read by statisticians. The Panel recognizes that this is a deliberate attempt to distinguish some of the less rigorous concepts involving laboratory uncertainty from those employed in a more strict statistical interpretation. Examples are “standard uncertainty” for “standard deviation” and “coverage factor” for “uncertainty interval” or “confidence interval”. For example, on page 19-10, lines 240-241, a statement is made that: “The uncertainty in x is expressed in the form of a standard deviation, called the standard uncertainty...”. However, on page 19-29, the standard uncertainty of an input estimate using the sample mean of n observations is given in equation 19.4 as the standard error, which is the standard deviation of a mean of size n . Therefore it is not clear whether the original definition of standard uncertainty is intended to mean the standard deviation (which does not depend upon sample size) or the standard error, i.e. standard deviation of a sample statistic which does depends upon the sample size. Perhaps what should be stated is that the standard uncertainty is the standard deviation of whatever statistic is chosen as an estimator of the input parameter as actually used in the analytic method, i.e. do not use the standard error of a mean of size n if the method only uses one replicate for that input parameter.

Other examples include vague definitions of “Type B” evaluations and counting efficiency. The former term should not be defined as “any evaluation of standard uncertainty that is not a Type A evaluation”, but rather as an evaluation based upon expert judgment. Similarly, counting efficiency should be defined in terms such as the ratio of analyte measured to the amount of analyte present.

The Panel realizes that the MARLAP Manual is directed at laboratory personnel who may be familiar with the terminology used in the current version. The Panel suggests, however, that statements be included to inform statisticians, who are likely to get involved, that many of the terms used are not directly translatable to corresponding statistical parameters or concepts with which statisticians may be more familiar.

5.3 Detailed Comments on Technical Content of Chapter 19

5.3.1 Technical Issues

The Manual needs to clarify its use of statistical approximations. The discussion of uncertainty propagation in subsections 19.5.3 (Combined Standard Uncertainty), 19.5.5.1 (uncertainty propagation for nonlinear models), and 19.5.5.2 (Bias) is incomplete and potentially misleading. In particular, the methods presented are only approximate but this caveat is not always clearly stated. For example, Equation 19.11 on page 19-33, for combined standard uncertainty, is only an approximation, not equality. However, the presentation does not clearly stress the approximate nature of the formula, nor does it indicate the conditions under which this

approximation would be valid. Both the use of an equal sign in the equation as well as the use of terminology such as “*the* uncertainty propagation formula” or the “*law* of propagation of uncertainty” give the impression that the relationship in Equation 19.11 is equality rather than an approximation.

In general, it would be helpful if the terminology and notation throughout Chapter 19 clearly indicated the approximate nature of most calculations. For instance, Table 19.1 shows all results as equalities, even though most formulas in the table are only approximate (except those for sums and differences). By contrast, in the last row, the table uses an “approximately equal” sign to indicate that $(\ln 10)^2$ is only *approximately* equal to 5.302. This latter result is at least accurate to four significant figures, while in some cases, the results presented as equalities might not be accurate to even a *single* significant figure!

Similar problems appear throughout Chapter 19. Admittedly, when uncertainties are small, the errors associated with the first-order Taylor polynomial are likely to be small. However, the Manual should clearly state whether a formula is an approximation when it is first introduced, and misleading notation and terminology should be avoided.

The Manual should incorporate discussion on the use of Monte Carlo analysis as an alternative means for estimating total uncertainties. Section 19.5.5.1 shows how to include higher-order terms in the uncertainty propagation formula. However, the version of the uncertainty propagation formula presented in this subsection assumes that “all the input estimates x_i are uncorrelated,” and no mention is made of Monte Carlo simulation as an alternative to the uncertainty propagation formula when uncertainties are substantial. The Subcommittee believes that when uncertainties are large and it is important to have a good estimate of their magnitude, Monte Carlo analysis is generally preferable to the use of Taylor series approximations. Even a second-order Taylor polynomial can be inaccurate when uncertainties are large and the function of interest is significantly nonlinear. Monte Carlo simulation does not have this drawback and can achieve any desired level of accuracy simply by increasing the number of realizations. The Manual should note this and provide one or more references. Comprehensive references on Monte Carlo simulation include *Simulation and the Monte Carlo Method* (Rubinstein, 1981) and *Monte Carlo: Concepts, Algorithms, and Applications* (Fishman, 1996). Briefer summaries are given in *Uncertainty: A Guide to Dealing With Uncertainty in Quantitative Risk and Policy Analysis* (Morgan and Henrion, 1992) and *Statistical Models in Engineering* (Hahn et al., 1994).

Section 19.5.5.2 is described as a discussion of bias. However, this section does not seem to use the term in the usual statistical sense, as discussed on pages 19-5 and 19-6, but rather refers to the potential inaccuracy of the Taylor polynomial approximation. Instead of providing an estimate of the error from use of the Taylor polynomial, the Panel suggests a qualitative discussion of situations in which this approximation is not accurate (e.g., when the uncertainties span a range sufficiently large that the function of interest is not approximately linear over that range). The Manual should recommend the use of Monte Carlo simulation in such cases.

The discussion in Attachment 19D, “Low-Background Detection Limits,” should be revised to explain when someone should consider formulas A, B, and C, the Stapleton approximation, or the exact test. If MARLAP intends to suggest a preferred method, it should be clearly stated, along with recommendations for situations when one of the other methods is preferable.

5.3.2 Use of Examples

Much of the material presented in Chapter 19 is at the limit or beyond the comprehension of laboratory personnel, managers, and planners. Although the material is generally technically sound, it is often too complex and presented with so much mathematical content that the targeted user will have much difficulty in trying to implement the estimation procedures. While the MARLAP Work Group may be reluctant to provide a “cookbook” approach to every procedure, an ordered set of steps in producing each estimate should be given. After each estimation procedure is outlined, it should be followed by a numerical example where each step is worked out with data values typical of radiological assays. The temptation to make the examples too simple should be avoided. For example, in Attachment 19E “Example Calculation,” the uncertainties for each input parameter are provided in the calculation of the combined uncertainty when it is doubtful that most laboratories would have already obtained all of these values. On the other hand, examples should not include factors that are unlikely to occur or have negligible effect. For example, is it really necessary to include the effects of buoyancy during weighing and other errors associated with pipettes?

Another potential problem with the current examples is that they seem to imply that the combined uncertainties associated with radiological measurements are small, particularly when compared to uncertainties often encountered in field sampling. For example, the total combined standard uncertainty in example 19E is only about 14% of the estimated measurand. Perhaps this is typical of radiological measurements, but we suspect that there may be considerably larger combined uncertainties. Examples of scenarios where one source of uncertainty may dominate and how this situation should be handled would be useful.

6. RESPONSE TO CHARGE QUESTION #4: OVERALL INTEGRATION AND IMPLEMENTATION ISSUES

Charge Question #4: *What are the overall integration and implementation issues?*

6.1 Integration Issues

As stated earlier in this review, the MARLAP Manual is extremely comprehensive and provides answers--or citations to documents with answers--to virtually all of the questions that might be asked about radiochemical analyses in support of environmental decisions. Moreover, its graded and flexible approach allows a user to select a set of analytical procedures suited to the complexity and importance of the problem being addressed. The Manual in general provides a convincing rationale for its recommendations, showing how decisions can be supported with sufficient but not excessive attention to analytical precision and reliability. The Panel offers the following comments, not in criticism, but in the hope of further improving a document that is already very good.

Careful reading of the MARLAP Manual reveals considerable attention to integrating it with the earlier MARSSIM document (MARSSIM, 2001). However, it might be useful to devote a short section early in the Manual to showing how the whole process is integrated for decisions regarding the cleanup of radioactively contaminated sites. Although the Panel recognizes that MARLAP is not limited to site cleanup decisions, they are probably the most important drivers for creating MARLAP.

What is the relationship of MARLAP to other analytical planning guidance issued or required by federal agencies? Primary sources of radiochemical methods for several of the authoring organizations are listed in Table 2. Unfortunately, few of these method resources fully reflect the proposed MARLAP guidance. However, many of the authoring organizations for the methods below are also participants in writing MARLAP. Therefore, these same organizations are well-positioned to revise these methods in a timely fashion following the finalization of MARLAP. Until these methods are revised to be consistent with MARLAP, the radiochemistry community will face a conflict between the MARLAP guidance and many of the methods in Table 2 that it is legally required to use. [Note: This list was provided to the Panel by Mr. Donovan Porterfield as part of his public comments. The Panel does not endorse the completeness or accuracy of Mr. Porterfield's list, offering it simply as a starting point for an effort by the MARLAP team to respond to our recommendation.]

The Panel believes that it would be useful to show, perhaps through a table of connections, how the MARLAP Manual interfaces with, augments, or replaces existing guidance on radiochemical analyses. Where some of that guidance may be found to be in conflict with MARLAP, perhaps the source agency should consider officially withdrawing it. Consequently, although it is outside our scope, we respectfully request a commitment from each of the authoring organizations on the time frame for their making revisions to radiochemical method resources issued by their organizations to fully reflect the MARLAP guidance. Otherwise, a mixed message will be sent to the user community: on the one hand, advocating the right way to do radiochemical analyses, while on the other hand likely legally requiring the usage of radiochemical methods that follow outdated practices.

Table 2. Analytical Planning Guidance Issued or Used by Agencies and Organizations Authoring MARLAP

<u>U.S. Environmental Protection Agency:</u>
EPA (no date) "Prescribed Procedures for Measurement of Radioactivity in Drinking Water", EPA 600/4-80-032.
EPA (1976) "Interim Radiochemical Methodology for Drinking Water", EPA 600/4-75-008 (revised), March 1976.
EPA (1987) "Radiochemistry Procedures Manual", EPA 520/5-84-006, December 1987.
EPA (1979) "Radiochemical Analytical Procedures for Analysis of Environmental Samples", March 1979.
40 CFR 61 Part B radiochemical methods.
EPA (1997) "Manual for the Certification of Laboratories Analyzing Drinking Water", EPA 815-B-97-001, March 1997.
<u>U.S. Geological Survey:</u>
USGS (1977) "Methods for Determination of Radioactive Substances in Water and Fluvial Sediments", Chapter A5 in Book 5 of Techniques of Water-Resources Investigations of the United States Geological Survey.
USGS (1976) "Selected Methods of the U.S. Geological Survey of Analysis of Wastewaters," Open-File Report 76-177.
<u>U.S. Department of Energy:</u>
DOE (1990) "EML Procedures Manual", 27 th Edition, Volume 1.
DOE (no date) Methods for Evaluating Environmental and Waste Management Samples.
<u>States:</u>
State of New York (1982) "Determination of Ra-226 and Ra-228 (Ra-02)", January 1980, Revised June 1982.
State of New Jersey (1980) "Determination of Radium 228 in Drinking Water", August 1980.
<u>ASTM International:</u>
ASTM (1994) Annual Book of ASTM Standards, Vol. 11.02.
<u>Standard Methods:</u>
"Standard Methods for the Examination of Water and Wastewater", 13th, 17th, 18th, 19th Editions, 1971, 1989, 1992, 1995.

6.2 Implementation Issues

6.2.1 Availability of a Trained Workforce

The MARLAP manual recommends that planning teams include “radioanalytical specialists”. Because single individuals rarely have substantial expertise in all the areas of interest to radioanalysis (e.g., wet chemistry, spectrometry, statistics, QA/QC), the teams may need either to include several such individuals or to recruit an individual with general knowledge of radioanalytical issues AND specially trained in the MARLAP process. In doing so, the widespread use of MARLAP may create a demand for such individuals that substantially exceeds the current supply. Declining interest in nuclear power and less emphasis on nuclear weapons as the centerpiece of US national security has allowed the pool of radioanalytic specialists to age and erode. The MARLAP agencies may need to stimulate a new generation of such experts through scholarship programs or other means in order to implement MARLAP as envisioned.

6.2.2 User Training

Although the planning process is straightforward and logical, the learning curve is steep at first. Well-designed training courses would be an efficient approach to get new users comfortable with the process more quickly. In designing these courses, the Panel recommends that the MARLAP Work Group meet with the MARSSIM team to find out the lessons learned by this team over the last couple years. For example, how has MARSSIM dealt with the highly variable starting points of prior experience and expertise among the course attendees? MARLAP is more likely to succeed if separate training courses are tailored for different audiences: managers, radioanalytical specialists, laboratory personnel, perhaps auditors. However, it will also be important for the courses to overlap at least slightly in coverage so as to enhance communication among user groups by ensuring that participants speak a common language and that all see how each fits into the “big picture.” The MARLAP team could also consider offering or coordinating some of the MARLAP training through National Environmental Laboratory Accreditation Conference (NELAC).

The Panel also recommends that role-playing exercises be part of the user training courses. The Subcommittee addressing the overall approach, i.e., responding to Charge Question #1, employed this tool at its April 24, 2002 work session. In order to get a sense of how a laboratory manager or other critical users might perceive MARLAP, the Subcommittee engaged in a role-playing exercise with members of the MARLAP Work Group. The scenario that was posed was based on a real situation in which elevated alpha activity had been detected in an unofficial groundwater sample collected from one of the monitoring wells adjacent to a privately-owned landfill. Subcommittee members took on the roles of the county administrator, landfill owner, representative of the State environmental regulatory agency, and a concerned citizen from the neighborhood adjacent to the landfill. MARLAP Work Group members adopted the roles of various types of “radioanalytical specialists:” analytical laboratory manager, an independent advisor for the county, and legal advisor to the landfill owner. The assignment to this group was to work through the MARLAP planning process described in Part I of the Manual. The radiochemical specialists were asked to direct the Panel members to the appropriate pages in the Manual that best described each step of the process.

1696 The exercise only lasted a half hour, during which time the group was able to come to
1697 consensus on the problem definition, decision identification, data inputs, and decision boundaries.
1698 Due to lack of time, the exercise did not proceed as far as developing decision rules, specifying
1699 limits on decision error rates, or developing DQOs, MQOs, APSs, or a SOW. Nonetheless, this
1700 cooperative exercise was invaluable for focusing attention of the group upon relevant advice
1701 provided in MARLAP. It not only facilitated the flow of information from the MARLAP Work
1702 Group to the Subcommittee, but also provided an opportunity for the Work Group to hear and
1703 understand the concerns of the Subcommittee, particularly in identifying areas where MARLAP
1704 guidance may be confusing, scattered, or not a practical guide for the user. Participants gained an
1705 appreciation for the critical importance of the appendices for key information needed to work
1706 through the planning process. Subcommittee members also became more cognizant of the very
1707 non-linear and iterative nature of the planning process, even starting at its first step. The exercise
1708 raised the awareness of the MARLAP Work Group with respect to several training issues: how to
1709 conduct training, what to include in it, how important it will be, and assumptions about the prior
1710 level of knowledge of the user community. All participants appreciated the highly variable
1711 “starting points” of prior experience and expertise, and recognized the challenge of designing
1712 training that takes this variability into account. The consensus was that scenarios and training
1713 will be critical to the success of MARLAP, by illustrating the planning process, driving home the
1714 potential benefits of the process, and “bringing it to life.”

7. SUMMARY OF RECOMMENDATIONS

7.1 Overall

The MARLAP Manual is extremely comprehensive and provides answers--or citations to documents with answers--to virtually all of the questions that might be asked about radiochemical analyses in support of environmental decisions. Moreover, its graded and flexible approach allows a user to select a set of analytical procedures suited to the complexity and importance of the problem being addressed. The Manual in general provides a convincing rationale for its recommendations, showing how decisions can be supported with sufficient but not excessive attention to analytical precision and reliability. The Panel offers the following comments, not in criticism, but in the hope of further improving the usability and user-friendly aspects of an already superior product.

7.2 Charge Question #1: Effectiveness and Clarity of the Overall Approach in Part I

1. The performance-based and flexible approach in MARLAP is appropriate and, for the most part, presented clearly and logically in the draft MARLAP Manual.
2. The guidance provided with regard to a graded approach for projects of different scope, as well as the emphasis on data quality sufficient for the decision being supported, is reasonable.
3. The linkage of the planning, implementation, and assessment phases of projects involving radioanalytical data is effective.
4. The Manual should undergo a thorough technical edit, the main objectives of which should be to (a) remove the considerable amount of redundancy, (b) ensure internal consistency among the chapters in presentation style and formatting, (c) make wider and more consistent use of effective techniques for presenting information, (d) proofread all references, equations, tables, figures, and examples, and (e) reduce the use of acronyms.
5. More examples should be included in the Manual to illustrate the planning process and the graded approach, so as to bring these to life for the reader. A variety of clearly presented and realistic scenarios will be critical to the success of MARLAP and should emphasize the potential benefits of planning and using a graded approach.
6. Provide a well-written Executive Summary using clear, simple text and figures to unify the document and show the linkages among the chapters.
7. A good overview figure is needed at the outset, a figure that lays out the entire planning process and shows the interrelationships among the steps.
8. Figures and tables should be designed so as to reinforce the text, or to help reduce the need for lengthy discussions. In particular, the very non-linear and iterative nature of the planning process should be indicated by feedback loops in figures to more clearly

convey the sense of the process of continual reassessing and fine-tuning the objectives and approaches.

9. References to good examples of process outputs (e.g., Statements of Work) from different agencies would be helpful.

10. The Manual should advise users on circumstances for which a much simpler approach would be appropriate.

11. The federal MARLAP Work Group should consider whether a simpler version of MARLAP could be prepared, that would be applicable to the \$10,000 to \$50,000 projects that involve taking no more than 10 to 20 samples and that cover a small area.

7.3 Charge Question #2: Technical Accuracy of the Guidance in Part II

12. Subject to the caveats listed in this review, Part II of the MARLAP document provides a much needed resource base for laboratory operations, and the Manual does a thorough job of explaining how decision-makers should make choices in the selection of hypotheses that help determine the confidence levels associated with the results obtained from analytical laboratories. Guidance provided in the Manual, on the whole, is reliable and well thought out.

13. Some technical inaccuracies and inconsistencies were identified. The Panel included the most important of these issues in the text of its Review Report and recommended some technical changes or additions to several of the chapters. Several instances are noted in which the compilation of sampling methods or sampling data needs is incomplete. Some technical inaccuracies in guidance or in generalizations were noted.

14. Re-organization of some of the chapters in Part II could add clarity and usefulness to the document. In particular, the presentation of information in Section 13.6, Section 13.7, Chapter 14, 15. Some of the text is overly variable with respect to level of detail, with some information either incomplete or not useful. Elsewhere a more logical order of presentation and appropriate cross-references between chapters would reduce confusion and repetition. Much of the discussion should probably be deleted, with the reader referred to specific publications for each special matrix (in Chapter 14) and radionuclide (in Chapter 15).

15. Guidance on reporting environmental radionuclide data should depend on the end use of the data and the necessary transmission of information to the reader. Specifically, care should be taken to report radionuclide concentrations even when they are negative due to subtraction of radionuclide background, or when they are below the minimum detection level (MDL) as determined from counting statistics. Such numbers should be reported and used in compiling or averaging results and for evaluating the reliability of measurements near the limits of detection. For use in describing environmental radioactivity to the public, such numbers should be replaced by "less-than" values or a statement of non-detectability. Depending on the level of knowledge of facility operators and regulators, negative and zero values may or may not be appropriately replaced by the non-detect or less-than notation in reports intended for their use.

16. Some of the main issues with MARLAP do not concern the content but the ease of its use as a practical tool. The implementation of radiochemical analyses is often driven by the requirements of existing methods, set as standards by different organizations. Until these methods are revised, and commitments from the authoring organizations are obtained, the radiochemistry community may be in conflict over the application of MARLAP guidance.

17. The quality of the guidance on laboratory operations can be much more sensitive to the largely subjective choices of the decision-makers than to the nuances of the laboratory process. Therefore, it is crucial that the guidance to these decision-makers be as precise and directed as possible, to avoid the misuse of this process. The Panel strongly supports the initiation and maintenance of a teaching program and the implementation of a web site for this purpose.

18. Part II should be divided into two parts to facilitate convenient use in the laboratory. A reasonable separation may be between Chapters 10 to 14 and Chapters 15 to 20. Dividing Part II into two parts would make the document more convenient for use by radiochemistry and radiation detection and quantification users. Such a division would also help with the current unwieldy physical size of the document in its present form, and in locating the needed information more quickly by the users. Appendices should be rearranged for inclusion with the respective volumes, so as to facilitate the ease of use.

7.4 Charge Question #3: Guidance on Measurement Statistics

19. From a technical perspective, statistical issues were addressed very well in the MARLAP Manual. Too much material was included in Chapter 19, the material is not presented in the most logical order, and the technical presentation was too complex for the target audience of laboratory directors and staff. Several suggestions for reorganization, simplification, and other revisions are made to enhance its value, specifically for laboratory directors and staff.

20. Many of the terms used in the measurement statistics chapter may be commonly employed in the jargon of laboratory science, but these terms are confusing when read by statisticians. Statements should be included to inform statisticians, who are likely to get involved, that many of the terms used are not directly translatable to corresponding statistical parameters or concepts with which statisticians may be more familiar.

21. The terminology and notation throughout Chapter 19 should clearly indicate the approximate nature of most calculations and clearly state whether a formula is an approximation when it is first introduced. It should also indicate the conditions under which each approximation would or would not be valid. If MARLAP intends to suggest a preferred method, it should be clearly stated, along with recommendations for situations when one of the other methods is preferable.

22. The Manual should incorporate discussion on the use of Monte Carlo analysis as an alternative means for estimating total uncertainties.

23. An ordered set of steps in producing each statistical estimate should be given. After each estimation procedure is outlined, it should be followed by a numerical example where each step is worked out with data values typical of radiological assays.

24. The current examples seem to imply that the combined uncertainties associated with radiological measurements are small, particularly when compared to uncertainties often encountered in field sampling. Examples of scenarios where one source of uncertainty may dominate and how this situation should be handled would be useful

7.5 Charge Question #4: Overall Integration and Implementation Issues

25. It might be useful to devote a short section early in the Manual to showing how the MARSSIM and MARLAP processes are integrated for decisions regarding the cleanup of radioactively contaminated sites.

26. It would be useful to show, perhaps through a table of connections, how the MARLAP Manual interfaces with, augments, or replaces existing guidance on radiochemical analyses.

27. Although it is outside our scope, we respectfully request a commitment from each of the authoring organizations on the time frame for their making revisions to radiochemical method resources issued by their organizations to fully reflect the MARLAP guidance. Otherwise, a mixed message will be sent to the user community: on the one hand, advocating the right way to do radiochemical analyses, while on the other hand likely legally requiring the usage of radiochemical methods that follow outdated practices.

28. The Panel recommends that the MARLAP Work Group meet with the MARSSIM team to find out the lessons learned by this team over the last couple years for developing well-designed training courses.

REFERENCES CITED

Note to Panel Members: All but 5 of these references are cited only in Table 2 and Appendix C of this report. Please consider whether all of these needed to be listed here. Also, some references need full citations and to be checked. JFM & KJK.

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APPENDIX A —DETAILED DESCRIPTION OF THE SAB PROCESS AND ITS CHARGE

The EPA Office of Radiation and Indoor Air (ORIA) requested that the Radiation Advisory Committee (RAC) of the Science Advisory Board (SAB) review the Multi-Agency Radiological Laboratory Protocols Manual (MARLAP). The RAC review was initiated in August 2000 while the MARLAP was still under development. The draft Manual was made available to the RAC in September 2001. The RAC review was completed in September 2002. This Appendix describes the details of the RAC review schedule and process.

A.1 Charge Questions and Subcommittee Assignments

Members of the MARLAP Review Panel addressed the specific charge questions posed by ORIA by organizing into subcommittees for each question, and allocating specific chapters and appendices to each subcommittee.

Charge Question #1:

Is the overall approach presented in Part I of MARLAP for the planning, implementation and assessment phases of projects which require analysis for radionuclides technically acceptable?

1a. Is the performance-based approach presented clearly and logically?

1b. Is the approach reasonable in terms of ease of implementation?

1c. Does the approach effectively link the three phases (planning, implementation, assessment) of a project?

Subcommittee chair: June Fabryka Martin

Subcommittee members: Steve Brown, Bruce Boecker, Jill Lipoti, Helen Grogan

Applicable MARLAP chapters:

Primary review materials: Chapters 1-9; Appendices A, B and C

Secondary review materials: Chapters 11 and 18

Charge Question #2:

Is the guidance on laboratory operations in the Part II chapters technically accurate? Does it provide a useful resource base of information for a laboratory's implementation of a performance-based approach?

Subcommittee chair: Bernd Kahn

Subcommittee members: Tom Gesell, Gilles Bussod, Gen Roessler¹, Shawki Ibrahim

¹ Dr. Genevieve Roessler Chaired this activity in the absence of Dr. Kahn at the April 23-25, 2002 meeting. She was assisted by Drs. Bussod, Gesell, and Ibrahim and others as appropriate.

Applicable MARLAP chapters:

Primary review materials: Chapters 6, 10-18 and 20; Appendix D

Secondary review materials: Chapters 1, 2, 5, 6 and 8

Charge Question #3:

Is the guidance on measurement statistics - specifically measurement uncertainty and detection and quantification capability - technically accurate, clearly presented, and useful for implementation by appropriately trained personnel?

Subcommittee chair: Richard Hornung

Subcommittee members: Vicki Bier, Mike Ginevan, Lynn Ansbaugh, Bobby Scott

Applicable MARLAP chapters:

Primary review materials: Chapter 19; Appendices B and E; Attachment B-1

Secondary review materials: Chapters 1, 3, 5, 6, 8, 17 and 18.3

Charge Question #4: The MARLAP Review Panel added this fourth charge question during a planning conference call:

What are the overall integration and implementation issues?

Subcommittee chair: Steve Brown

Subcommittee members: All MARLAP Review Panel members and consultants

Applicable MARLAP chapters: All materials, and possibly additional supplemental items from other sources.

A.2 Panel Review Schedule and Process

The SAB Staff recruited Dr. Jan Johnson, Chair of the Radiation Advisory Committee (RAC) of the Science Advisory Board (SAB), to serve as Chair of the MARLAP Review Panel. Working with the Chair, other SAB members and consultants, Agency Staff, and suggestions from the public, the SAB Staff developed a list of over ___ scientists and engineers ("Wide Cast") whose expertise appeared to be relevant to answering the questions in the Charge. Subsequently, the Chair, the Staff Director and the Designated Federal Official (DFO) reviewed the list in some detail and identified ___ individuals ("Narrow Cast") to contact regarding their interest and availability to participate on the Panel. Based on this information and the importance of having a balanced range of views on the technical issues represented on the Panel, the Chair and the DFO made recommendations for membership to the Staff Director, who made the final decision on the composition of the Panel. This process included assigning Lead and Associate responsibilities to specific Panel members for each of the Charge questions.

The Agency transmitted review materials to the MARLAP Review Panel members in September 2001. On (add date) the SAB Staff convened a publicly-accessible, Federal Register-noticed conference call meeting between Panel members and Agency staff. The RAC also held face-to-face planning meetings on (insert dates). A public conference call was held on April 8, 2002. The goal of this information-gathering meeting was to clarify any questions that Panel

members might have, to identify any gaps in the information sent to the Panel, and to identify areas that the Agency and the MARLAP Work Group should be prepared to clarify at the face-to-face meeting. The MARLAP Review Panel added a fourth charge question during this planning conference call dealing with overall integration and implementation issues.

On April 23 through 25, 2002 the Panel convened in the EPA Headquarters Building, EPA East Building Hearing Room 1153, Washington, DC. The MARLAP Work Group participating in this review included technical staff from the following agencies, departments and commissions: the U.S. Environmental Protection Agency (EPA), Office of Radiation and Indoor Air (ORIA), the Department of Energy (DOE), the Department of Defense (DOD), the Nuclear Regulatory Commission (NRC), the National Institute of Standards and Technology (NIST), the U.S. Geological Survey (USGS), and the U.S. Food and Drug Administration (FDA). State participation in the development of the Manual involved contributions from representatives from the Commonwealth of Kentucky and the State of California.

During the April 23 - 25, 2002 public meeting, the MARLAP Review Panel heard presentations from the Agency and MARLAP Work Group staff on the first day. Public comments were received from Mr. Donovan Porterfield in advance of the meeting. No additional public comments were received at this meeting. The presentations were followed by detailed discussion by the MARLAP Panelists on the four charge questions in break-out sessions held in smaller rooms adjacent to or in close proximity to the EPA Hearing Room, in which all participants were invited to participate. The second day saw continued break-out session discussions, a re-convening of the MARLAP Review Panel to discuss its progress and next tasks, the making of additional writing assignments by the subcommittee chairs. The discussion in the break-out sessions focused on key points within each charge question, as well as re-writing of the pre-meeting written comments by the Panelists to their assigned charge questions, and teaming in groups by the Panelists to develop merged language edits.

By the end of the second day, the individual comments and merged edits were discussed by the Panelists within each of the Working Groups. The third day was engaged with more refinements of the written materials and focused discussions within each of the subcommittees. The MARLAP Review Panel decided to exercise their option to conduct a planned technical editing public conference call in June 27, in which the public can follow the Review Panel's discussions on the working draft, which is not yet a public consensus report. The Review Panel anticipates that a public consensus draft would be completed at the end of August, and plan to hold a second public face-to-face meeting at the end of September to reach closure on edits to that draft report. The draft ... (continue here) The first "working" public draft was developed on (add date) and posted on the SAB website on (add date) (www.epa.gov/sab under "draft reports") for discussion at the (Sept meeting).

.....continue the MARLAP Review Panel held a public meeting to reach closure on September 24 -26, 2002 in which the first public draft report, dated August 29, 2002 was shared with all parties and on which public comments were solicited. Following receipt of Panel and public comments, a revised working draft dated (add date) was prepared and the Panel convened a technical editing (non-FACA) work session on (AddDate) to complete the edits. Following this work session, the edits were incorporated into a second public draft report dated (add date). This draft was posted on the SAB web site (www.epa.gov/sab under "draft reports") for access by the public (including the Agency). A public closure meeting was held on (add date)

in which the MARLAP Review Panel conducted final edits and the public was given an opportunity for closure comments. Following this (add date) meeting, a (add date) public draft was prepared for a vetting review by the SAB's Executive Committee on (add date), at which meeting the public was invited to comment by the Chair of the SAB Executive Committee. The Chair of the MARLAP Review Panel conferred with the SAB Executive Committee discussants and completed the edits to this advisory, resulting in this final version being submitted to the Administrator.

NOTE: Throughout the process, the SAB has provided announcements in the Federal Register, as well as posting notices, agendas, and the publicly-available draft reports on the SAB website (www.epa.gov/sab), along with related efforts to reach out to all potentially affected and interested parties. This also included a public conference call meeting prior to the April, 2002 face-to-face public meeting to discuss and negotiate the charge, determine if the review materials are adequate, and begin the pre-meeting review and writing process. The MARLAP Work Group also provided a URL site for the MARLAP Manual and received extensive public comments as well as comments from all the Agencies, departments and commissions involved, including review materials, appendices, background briefings and related materials.

APPENDIX B GLOSSARY

Note to Panel Members: Most of these acronyms appear only in Appendix C of this report. Consider whether these need to be included here, or whether this glossary should be limited to those used in the main body of the review report.

"	Probability of a Type I error, false positive; also, alpha particle (type of radiation)
\$	Probability of a Type II error, false negative; also, beta particle (type of radiation)
: m	Micron
AEA	Atomic Energy Act
APS	American Physical Society; also Analytical Protocol Specifications
ASTM	American Society for Testing and Materials
AQCS	?...?...? Analytical Quality Control System (?)
Ba	Barium, as an element or its isotopes
Be	Beryllium, as an element or its isotopes
Cd	Cadmium, as an element or its isotopes
CD	Compact Disk
CFR	Code of Federal Regulations
cm	Centimeter
Cs	Cesium, as an element or its isotopes (e.g., Cs-137)
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DQO	Data Quality Objective
EML	Environmental Measurements Laboratory (DOE)
EPA	U.S. Environmental Protection Agency
FACA	Federal Advisory Committee Act
FDA	U.S. Food and Drug Administration
Ge	Germanium, as an element
GUM	<i>Guide to the Expression of Uncertainty in Measurement</i> (ISO, 1995)
HASL	Health and Safety Laboratory (renamed as the Environmental Measurements Laboratory in 1977, EML)
h	Hour
H-3	Hydrogen-3 (tritium), a radioactive isotope of hydrogen
HF	Hydrogen Fluoride
IAEA	International Atomic Energy Agency
IO ₃	Iodate
ISO	International Organization for Standardization
IUPAC	International Union of Pure and Applied Chemistry
m	Meter

2185	mm	Millimeter
2186	MARLAP	Multi-Agency Radiological Laboratory Analytical Protocols (Manual)
2187	MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
2188	MCA	<u>M</u> ultichannel <u>A</u> alyzer
2189	MDC	Minimum Detectable Concentration
2190	MQO	Measurement Quality Objective
2191	n	Neutron
2192	NaI	Sodium Iodide
2193	NAREL	National Air and Radiation Environmental Laboratory (U.S. EPA)
2194	NELAC	National Environmental Laboratory Accreditation Conference
2195	NIM	?.....? [NOTE: appears on p. 15-46, line 1419, "poorly conditioned NIM power"]
2196		
2197	NIST	National Institute of Standards and Technology (U.S.)
2198	NRC	U.S. Nuclear Regulatory Commission
2199	ORIA	Office of Radiation and Indoor Air (U.S. EPA)
2200	Pb	Lead, as an element or its isotopes (e.g., ²¹⁰ Pb)
2201	PDF	Probability Density Function
2202	pH	Negative log of hydrogen ion concentration
2203	P _i	? ? ?
2204	PMT	<u>P</u> hotomultiplier <u>T</u> ube
2205	Po	Polonium, as an element (Po), or as an isotope (e.g., ²¹⁰ Po, ²¹⁴ Po)
2206	PTFE	<u>P</u> olytetrafluoroethylene
2207	Pt	Platinum, as an element
2208	Pu	Plutonium, as an element (Pu), or as an isotope (e.g., ²³⁸ Pu, ²³⁹ Pu, ²⁴⁰ Pu)
2209	QA	Quality Assurance
2210	QAPP	Quality Assurance Project Plan
2211	QC	Quality Control
2212	R	Roentgen, an international unit of X-ray or gamma radiation
2213	Ra	Radium, as an element or its isotopes (²²⁰ Ra, ²²² Ra, ²²⁶ Ra, ²²⁸ Ra)
2214	RA	?.....? Risk Assessment (?)
2215	RAC	Radiation Advisory Committee of the Science Advisory Board, U.S. EPA
2216	RAP	Radiological Analytical Protocols
2217	Rn	Radon, as an element and its isotopes (220Rn, 222Rn)
2218	s	Second (time)
2219	SAB	Science Advisory Board (U.S. EPA)
2220	SCBA	Self-Contained Breathing Apparatus
2221	SI	International System of Units
2222	SOW	Statement of Work
2223	Sr	Strontium, as an element or its isotopes (⁸⁸ Sr, ⁸⁹ Sr, ⁹⁰ Sr)
2224	Tc-99	Technetium-99
2225	TENORM	Technologically Enhanced Naturally Occurring Radioactive Material
2226	Th	Thorium, as an element or its isotopes (e.g., ²²⁹ Th, ²³⁰ Th, ²³² Th)
2227	Tl	Thallium, as an element

2228	Type A	?.....? statistical error terminology (to be provided) (?)
2229	Type B	?.....? statistical error terminology (to be provided) (?)
2230	U	Uranium, as an element or its isotopes (e.g., ²³³ U, ²³⁴ U, ²³⁵ U, ²³⁶ U, ²³⁸ U)
2231	USGS	U.S. Geological Survey
2232	uv	Ultraviolet, used of radiation having a wavelength shorter than that of
2233		visible light and longer than those of x-rays
2234	Xc	Measurement
2235	Xd	Distribution error
2236		

APPENDIX C COMPILATION OF REVIEW COMMENTS

This master list of comments is intended to be limited to technical comments or major editorial comments. Although substantial overlap may exist with this list, suggestions for minor changes in wording and typos have been transmitted separately to the federal MARLAP Workgroup through ORIA (Kooyoomjian, 2002). Comments compiled in this appendix are not consensus comments. They represent the opinions of individual members of the Review Panel and should not be construed as formal comments of the RAC or the SAB.

Some of the comments in this appendix have also been included in the main body of this report. In this case, they can be considered to represent the consensus of the Panel members and formal comments of the RAC and the SAB. The following criteria were used to identify these comments:

1. Does the comment relate to organization of a chapter or the MARLAP as a whole?
2. Does the comment relate to the credibility of the MARLAP or its usefulness to the user?
3. Does the author of the comment feel strongly that it belongs in the body of the report?

The appendix lists the reviewer comments in order of the chapter to which they pertain. Additional columns classify each comment according to various criteria:

1. **DESCRIPTOR** describes the part of MARLAP to which the comment applies:
Appendix, Body Text, Equation, Figure, Footnote, General, Reference, Table, TOC (Table of Contents)
2. **CATEGORY** distinguishes each comment as either technical or editorial in nature
3. **CLASSIFICATION** indicates the specific type of reviewer comment
Clarification: Manual text requires clarification on this point
Commentary: Comments from RAC that do not involve specific suggestions
Format: Specific to formatting issues
Organizational/structural: Specific to reorganization and suggestions pertaining to the overall structure of the MARLAP document
Suggestion: Changes suggested by the RAC
Terminology: Specific to the use of technical terms
Typo: Relating to any typographical correction

Note to Panel Members: The full data base (sent as a separate file) also contains additional columns that classify each comment by originator. The Panel members should use the full data base to (a) check the accuracy and completeness of their own comments, (b) check that all significant comments in this data base have been captured in the main text of the review report, and (c) suggest changes as needed for this file to be forwarded to the federal MARLAP Work Group.

SOURCE: originator of comments (this column will not be included in the final report itself)

JJ: Janet Johnson

LA: Lynn Anspaugh

BB: Bruce Boecker

GB: Gilles Bussod

TG: Thomas Gesell

HG: Helen Grogan

RH: Richard Hornung

JL: Jill Lipoti

GR: Genevieve Roessler

VB: Vicki Bier

SB: Stephen Brown

MG: Michael Ginevan

SI: Shawki Ibrahim

BK: Bernd Kahn

JM: June Fabryka-Martin

BS: Bobby Scott

G1: Group 1

G2: Group 2

G3: Group 3

APPENDIX C. Compilation of MARLAP Panel Review Comments

2303	Row	Source	Category	Classification	Chap	Section	Page	Line	Comment
2304	1	JM	Technical	Style	0	Abstract	III		The abstract should summarize the scope and main points in the Manual, and shorten or cut the extensive paragraph about the process (and participants) who created it. The multiagency aspect is, of course, significant but more appropriate in an Executive Summary. It also already appears in two other places in the front matter (Notice, Acknowledgments).
2305	2	JM	Editorial	Typo	0	TOC	X		Typo in title for section 2.5: Directed
2306	3	JM	Editorial	Typo	0	List of figs	XLII	Fig 14.4	Missing first word of figure caption ("The")
2307	4	JM	Editorial	Typo	0	List of figs	XLII	Fig. 14.1	Figure 14.1 caption includes a mysterious superscripted number (1)
2308	5	JM	Editorial	Format	0	Acronyms	XLVII		I like the format of this list, in which bracketed numbers indicate the first chapter in which the acronym appears.
2309	6	JM	Editorial	Suggestion	0	Acronyms	XLVII		Proposed additions to acronym list: parameter symbols, at least the most common ones (alpha, beta, del, sigma). Also ACE, Bq, NIM, MCL [2:289], GEDD [17:1031].
2310	7	JM	Technical	Clarification	0	Acronyms	XLVIII		Check whether the I in ERPRIMS stands for anything (a logical guess would be "Information").
2311	8	JM	Editorial	Typo	0	Acronyms	XLVIII		ESC actually first appears in Chapter 2, on page 2-5, lines 119-120
2312	9	JM	Editorial	Format	0	Acronyms	XLVII		I think some of the acronym definitions should probably be capitalized instead of all lower case. Examples: SAFER, ESC, DQO. Seems to be a bit arbitrary as to when an acronym's definition is capitalized and when it is not (e.g., SOW but not RFP or RFQ).
2313	10	JM	Editorial	Typo	0	Acronyms	XLIX		MDC actually first appears in Chapter 2, on page 2-16, line 451
2314	11	JM	Editorial	Clarification	0	Acronyms	LI		I suggest that the definition of TPP be followed by "[process] (ACE)"
2315	12	JJ	technical	commentary	1	1.1	1-1	6	The document states that failing to remediate a radioactively contaminated site could be costly in many ways. It should also note that going too far in the remediation process is costly as well.
2316	13	JM	Editorial	Grammar	1	1.1	1-1	6	Change "its" to "their"
2317	14	JM	Editorial	Style	1	1.1	1-1	12-14	"MARLAP provides guidance in the planning, implementation and assessment phases for those projects that require the laboratory analysis of radionuclides." This is but the first time that this sentence appears in Chapter 1; altogether it appears 6 times, which is a few times too often. Although appropriate here, some of the other occurrences should be deleted.
2318	15	JM	Editorial	Terminology	1	1.1	1-1	17	Is this Volume I, as indicated on the cover, or Part I, as listed here? Personally, I vote for Volume instead of Part, particularly since Chapter 15 also has a Part I and II.
2319	16	JM	Editorial	Terminology	1	1.1	1-1	24	Decide whether this should refer to Volume II, as indicated on its cover, or Part II, as listed here.
2320	17	JM	Editorial	Style	1	1.1	1-1	29-31	Replace lines 29-31 with the following text: "...analytical procedures but rather is intended to provide information on many of the options available for analytical measurements, and ..."
2321	18	JM	Editorial	Style	1	1.2	1-2	40-56	This paragraph is about twice as long as it should be. All of its concepts are stated twice, with excessive overlap in the wording of consecutive sentences. And then the same concepts are echoed yet again in the bullets on lines 58-68.
2322	19	JM	Editorial	Style	1	1.2	1-2	51-52	Repeat of the sentence from the previous page (lines 12-14). It could be deleted without any loss of

APPENDIX C. Compilation of MARLAP Panel Review Comments

Row	Source	Category	Classification	Chap	Section	Page	Line	Comment
2323	20	JM	Editorial	Style	1	1.2	1-2	52-56 information. All of these final sentences in this paragraph should probably be deleted for being repetitious of the first part of the paragraph..
2324	21	JM	Editorial	Grammar	1	1.2	1-2	56 Change "its" to "their"
2325	22	JM	Editorial	Style	1	1.2	1-3	69-71 Very similar to sentences on the previous two pages (lines 12-14, 40-42 and 51-52), as well as its wording being echoed in lines 73-79. It could be deleted without any loss of information.
2326	23	JM	Technical	Suggestion	1	1.3	1-3	91 It would be useful here to expand upon the relationship between MARLAP and MARSSIM, their areas of overlap as well as their differences in scope and coverage. A table might be the best way to show this comparison and linkage.
2327	24	JM	Editorial	Style	1	1.3	1-4	103-104 Very similar to sentences on the previous three pages (lines 12-14, 40-42, 51-52, 69-71).
2328	25	JM	Technical	Suggestion	1	1.3	1-4	106-108 It would be appropriate to mention here that MARSSIM does provide guidance on these issues (or make this clear in the proposed table mentioned in the comment for line 99).
2329	26	JM	Technical	Organization	1	1.4	1-4	111 I think it would be better to move section 1.5 to precede section 1.4. Otherwise, one wades through 10 pages of discussion on terminology before finally seeing how all the pieces are supposed to fit together. A figure showing "the big picture" should also be introduced at this point. Possible contenders are Figures 1.1 or 1.3 in MARLAP, Figure D-2 from MARSSIM, or something similar to Figure 1 in the Panel's review report.
2330	27	JM	Technical	Clarification	1	1.4.1	1-4	123 Insert a new introductory sentence that clarifies the connection between MARLAP and the data life cycle, e.g., "MARLAP implements the data life cycle approach for the specific case of radionuclide data."
2331	28	JM	Technical	Suggestion	1	1.3	1-4	99 It would be useful here to be more explicit about what MARLAP does and does not cover, similar to Table 1.1 in MARSSIM as an example and perhaps combined with the table suggested in the comment for line 91.
2332	29	JM	Editorial	Style	1	1.4.1	1-5	133-135 Delete the last sentence; it is unnecessary for this discussion of the data life cycle and repetitive of numerous other occurrences of this wording in this chapter.
2333	30	JM	Editorial	Style	1	1.4.1	1-5	136-155 This paragraph is about twice as long as it should be due to excessive and distracting overlap in the wording of consecutive sentences.
2334	31	JM	Technical	Format	1	1.4.1	1-5	Fig 1.1 Figure 1.1 is misleading because it implies a linear process; in reality, the data life cycle process has numerous feedback loops.
2335	32	JM	Editorial	Typo	1	1.4.1	1-5	Fig 1.1 Note that QC, which appears in Fig 1.1, has not yet been defined for the reader at this point.
2336	33	JM	Editorial	Format	1	1.4.1	1-5	Fig 1.1 The font in Fig. 1.1 is uncomfortably small for us post-40-yr-old readers.
2337	34	JM	Editorial	Style	1	1.4.2	1-6	161 Delete unnecessary verbiage: "While MARLAP recommends and promotes the use of a directed planning process," This wording is a distracting echo of that used just 4 lines earlier (line 157)
2338	35	JM	Editorial	Style	1	1.4.3	1-6	168-179 All of the ideas in this first paragraph are repeated in the second one. This first paragraph should be altogether deleted.
2339	36	JM	Editorial	Style	1	1.4.3	1-6	173-175 Very similar to sentences on the previous 5 pages (lines 12-14, 40-42, 51-52, 69-71, 103-104)
2340	37	JM	Editorial	Style	1	1.4.3	1-6	187-188 Delete the sentence, "MARLAP provides guidance in all three of these areas." Throughout section 1.4, the focus should be on discussing the title concept in each subsection, and that discussion should not be diluted with side comments about MARLAP.
2341	38	SB	technical	commentary	1	1.4.4	1-7	198-201 This phrase states that " <i>MARLAP does not provide general guidance on the sampling process, except for brief discussions of certain activities that affect the analytical process...</i> " However in later

APPENDIX C. Compilation of MARLAP Panel Review Comments

	Row	Source	Category	Classification	Chap	Section	Page	Line	Comment
									chapters, there are recommendations on sampling, e.g., the recommendation to sample milk from downwind cows in section 10.3.4.1.
2342	39	JM	Editorial	Style	1	1.4.4	1-7	221	Delete phrase, "It should be noted that"
2343	40	JM	Editorial	Style	1	1.4.4	1-7	228	Delete "for the various activities."
2344	41	JM	Technical	Format	1	1.4.4	1-7	Fig 1.2	Fig 1.2 is identical to Fig 3.1 on page 3-3 and very similar to Fig 6.1 on page 6-3. Personally I like Fig 6.1 best (although I may be biased by its larger font size) because it illustrates the distinction between the analytical "process" and "method".
2345	42	JM	Editorial	Typo	1	1.4.4	1-7	Fig 1.2	Note that QA/QC, which appears in Fig 1.2, has not yet been defined for the reader at this point.
2346	43	JM	Editorial	Format	1	1.4.4	1-7	Fig 1.2	The font in Fig. 1.2 is uncomfortably small for us post-40-yr-old readers.
2347	44	G1	technical	commentary	1	1.4.4	1-7	Fig 1.2	Figures 1.2 and 1.3 are static and linear; these should have feedback loops to more clearly convey the sense of the process of continual reassessing and fine-tuning the objectives and approaches.
2348	45		technical	terminology	1	1.4.6	1-8	248	Many analytical methods do not require "... <i>sample digestion</i> ..." as implied here. When speaking generally of the analytical method, it would be more inclusive to refer to <i>sample preparation and counting</i> .
2349	46	JM	Editorial	Style	1	1.4.4	1-8	229-232	This paragraph could probably be deleted.
2350	47	JM	Editorial	Typo	1	1.4.4	1-8	232	Missing period
2351	48	JM	Editorial	Style	1	1.4.5	1-8	237	Delete "the relevant activities, such as"
2352	49	JM	Editorial	Style	1	1.4.5	1-8	240-242	Delete the sentence starting with "A written procedure..." This is an unnecessary detail.
2353	50	JM	Technical	Style	1	1.4.5	1-8	241-243	Replace this sentence with the shortened one: "A number of alternative protocols might be appropriate for a particular process." This is true regardless of whether or not a performance-based approach is being used.
2354	51	JM	Editorial	Style	1	1.4.5	1-8	243-245	Delete the last sentence. It is unnecessary in this discussion on the concept of an analytical protocol.
2355	52	JM	Editorial	Style	1	1.4.6	1-8	249-251	Delete the second and third sentences of this paragraph, along with the first word ("However") of the fourth sentence.
2356	53	JM	Editorial	Style	1	1.4.6	1-8	255-257	Delete the last sentence of this paragraph.
2357	54	JM	Editorial	Style	1	1.4.7	1-8	258-305	This section was well-written.
2358	55	JM	Editorial	Style	1	1.4.7	1-8	260	Awkward wording: "generally the word always refers to...." Delete either "generally" or "always".
2359	56		technical	terminology	1	1.4.7	1-9	276	Suggest <i>expanded uncertainty</i>
2360	57	JM	Editorial	Typo	1	1.4.7	1-9	276	Typo: "expanded"
2361	58	SB	technical	terminology	1	1.4.7	1-9	279-289	Here and elsewhere in the document, the word "uncertainty" is used to describe the inability of any procedure to measure some true value exactly. Sometimes, however, a decision depends on the variability of true values for a parameter, as with variable soil concentrations over a contaminated site. In that case, the important uncertainty may be about the true value of, say, the mean, and depends on the sampling strategy as well as the analytic procedure. From reading the whole Manual, I am sure the MARLAP team is well aware of the distinction between uncertainty and variability--and that variability in one parameter can lead to uncertainty about another. But perhaps it should reveal that understanding fairly early in the document, perhaps by directing the reader to a detailed discussion later, e.g., in Chapter 19.
2362	59	JM	Editorial	Grammar	1	1.4.7	1-9	292	Replace "since" with "because". "Since" is used to refer to passage of time (although I know this rule of thumb is commonly ignored).
2363	60	SB	technical	clarification	1	1.4.8	1-10	311	The statement that "bias . . . does not vary" seems to me not quite right. If you find out that the butcher has his thumb on the scale, that would be bias, but the amount of the overage would not necessarily be

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	Row	Source	Category	Classification	Chap	Section	Page	Line	Comment
2364	61	JM	Editorial	Grammar	1	1.4.7	1-10	301	the same from package to package. Replace "since" with "because".
2365	62		technical	commentary	1	1.4.8	1-10	306 ff	This is a wonderful discussion on precision, bias, accuracy, uncertainty, etc.
2366	63	JM	Editorial	Style	1	1.4.8	1-10	306-348	This section was well-written.
2367	64	JM	Editorial	Grammar	1	1.4.8	1-10	309	Replace "since" with "because".
2368	65	JM	Editorial	Style	1	1.4.8	1-10	323-324	Delete "depending on one's point of view"
2369	66	JM	Editorial	Typo	1	1.4.8	1-10	324	Correct section reference to "1.4.7"
2370	67	JM	Editorial	Style	1	1.4.8	1-10	326-332	Suggest deleting these last 3 sentences. They are a bit confusing and seem an unnecessary level of detail for this discussion.
2371	68	JM	Editorial	Grammar	1	1.4.8	1-10	328	Replace "is" with "are"
2372	69	JM	Editorial	Grammar	1	1.4.8	1-11	335	Replace "since" with "because".
2373	70	JM	Editorial	Grammar	1	1.4.9	1-11	352-354	Replace semi-colons with commas.
2374	71	JM	Technical	Clarification	1	1.4.9	1-11	356	I don't understand the distinction between "total uncertainty" (line 356) and "expanded uncertainty" (line 276). Are these synonymous?
2375	72	JM	Editorial	Style	1	1.4.9	1-12	376-383	In this paragraph, the same basic concept is repeated three times, reworded each time for a different emphasis or level of detail. This repetitiveness is distracting to the reader.
2376	73	JM	Editorial	Grammar	1	1.4.10	1-12	387	Replace "since" with "because".
2377	74	JM	Editorial	Style	1	1.4.10	1-12	387-389	Delete the second half of this sentence because this is the subject of the following paragraph that starts on line 396; no need to state it twice. Deleted part: ", and since most projects require that a number of different analyses be performed, several APSs will normally be developed for a particular project."
2378	75	JM	Editorial	Style	1	1.4.10	1-13	399-402	Delete the sentence starting with "However, the level of specificity.." because this was discussed in the previous paragraph on lines 391-392. Move the following sentence about the one-page form to the end of the previous paragraph (line 395). Delete the last sentence; it's already been said.
2379	76	JM	Editorial	Style	1	1.4.10	1-13	403-408	Could probably delete this paragraph because the focus is on the MARLAP process, not defining the concept of APSs.
2380	77	JM	Editorial	Style	1	1.4.11	1-13	410-412	Delete the first sentence, and replace "The" with "MARLAP's" in the second.
2381	78	JM	Editorial	Typo	1	1.4.11	1-13	416	Delete left parenthesis
2382	79	JM	Editorial	Typo	1	1.4.11	1-13	417	Missing period
2383	80	JM	Technical	Organization	1	1.5	1-14	444-475	It would make sense to move this section to precede Section 1.4.
2384	81	JM	Editorial	Style	1	1.6	1-15	477-493	Summarize the first two paragraphs in just a couple sentences with minimal detail. More detailed information should only appear in the subsections.
2385	82	JM	Editorial	Style	1	1.6	1-15	477-497	Delete these three paragraphs; it's all covered (or should be) in subsections 1.6.1 and 1.6.2
2386	83	JM	Editorial	Style	1	1.6	1-15	477-576	Section 1.6 needs a thorough edit to reduce its repetitious nature by streamlining the descriptions of Parts I and II, and using a consistent format and level of detail for the 3 subsections. Specific suggestions are made in separate comments.
2387	84	JM	Editorial	Style	1	1.6	1-15	494-497	I suggest deleting this paragraph and follow through by setting a goal of minimizing the extent to which information is repeated in detail throughout MARLAP.
2388	85	JM	Technical	Format	1	1.6	1-16	Fig 1.3	I like this figure as a roadmap to the chapters in Part I. However, it should also show key feedback loops

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	Row	Source	Category	Classification	Chap	Section	Page	Line	Comment
2389	86	JM	Editorial	Style	1	1.6	1-16	Fig 1.3	The use of acronyms in Fig 1.3 is somewhat inconsistent. For example, in the top box, APSs is spelled out but MQOs is not. In the box for Chapter 5, shouldn't the acronym in parentheses be APSs instead of MQO?
2390	87	G1	technical	commentary	1	1.6.1	1-16	Fig 1.3	Figures 1.2 and 1.3 are static and linear; these should have feedback loops to more clearly convey the sense of the process of continual reassessing and fine-tuning the objectives and approaches.
2391	88	JM	Editorial	Organization	1	1.6.1	1-17	499	It's a minor point, but I think Chapter 1 should be considered to be part of Part I (or is it Volume I?).
2392	89	JM	Editorial	Style	1	1.6.1	1-17	499-527	A more user-friendly format would be a short introductory paragraph, followed by bullets for each chapter, similar to the format used for Appendices A-C on lines 580-587 in section 1.6.3. Figure 1.3 should be cited early in this subsection. Otherwise, the second paragraph should be largely dropped, particularly lines 523-527; this subsection is not the place to be discussing details of MARLAP.
2393	90	JM	Editorial	Style	1	1.6.1	1-17	500	Replace the last part of the first sentence so that it reads "an overview of the directed planning process and its outputs."
2394	91	JM	Editorial	Style	1	1.6.2	1-17	529-576	Edit to make this a more user-friendly presentation with minimal repetition of information (no need to state three times that Part II does not contain step-by-step instructions!). I suggest starting the section with a succinct introductory paragraph and using bullets to describe (in a sentence or two) the contents of each chapter in Part II.
2395	92	JM	Editorial	Typo	1	1.6.2	1-18	550	Need to correct the title listed for Chapter 10
2396	93	JM	Editorial	Typo	1	1.6.2	1-19	550	Need to correct the title listed for Chapter 10
2397	94	JM	Editorial	Style	1	1.6.3	1-19	578	Delete "to both Part I and Part II of the manual" and replace "several" with "the following"
2398	95	JM	Editorial	Style	1	1.6.3	1-19	579	Delete the last sentence.
2399	96	JM	Editorial	Typo	1	1.6.3	1-19	583	Replace "Data Quality Objectives" with "DQO" to match the title that appears in the Table of Contents and at the beginning of this Appendix
2400	97	JM	Editorial	Terminology	1	1.6.3	1-19	587	Should "select" be "selected"?
2401	98	JM	Editorial	Style	1	1.6.3	1-19	588-594	Note that the bullets for Appendices D through G don't describe their contents except by restating the titles; I suggest just listing the titles alone.
2402	99	JM	Editorial	Typo	1	1.7	1-20	605	Couldn't get to the web site using this address. Replace "/filesfin.htm" with "/obtain.htm"
2403	100	JM	Editorial	Typo	1	1.7	1-20	607	Capitalize the first letter in "Available". Verify the web site address.
2404	101	BB	technical	commentary	1	1.4.1	1-5	Fig 1.1	I liked this Figure 1.1 because it clearly presented the concept of a Data Life Cycle without a lot of words.
2405	102	JM	Editorial	Style	2	2.1	2-1	11	Replace "of" with "on"; replace "achieve" with "support" (to match the use of this word on line 4).
2406	103	JM	Editorial	Grammar	2	2.1	2-1	13	Refer to plural: "objectives" and "are"
2407	104	JM	Editorial	Grammar	2	2.1	2-1	20	Add some punctuation to this phrase, e.g. "...experts--in particular, radioanalytical specialists--in the planning..."
2408	105	JM	Editorial	Style	2	2.1	2-1	24	Spell out SOW
2409	106	JM	Editorial	Style	2	2.1	2-1	25	Delete "--DQA"
2410	107	JM	Editorial	Style	2	2.1	2-1	26	Provide a more specific cross-reference here (Section 1.4.9 instead of to just Chapter 1).
2411	108	JM	Editorial	Grammar	2	2.1	2-1	26	Use the present tense instead of the future tense by replacing "will use" with "uses".
2412	109	JM	Editorial	Style	2	2.1	2-1	3-12	This first paragraph should be briefer and allow lines 14-25 to expand on the objectives. Suggested edit: Keep lines 3-5, delete lines 6-9, and keep the italicized text in lines 9-12.

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	Row	Source	Category	Classification	Chap	Section	Page	Line	Comment
2413	110	JM	Technical	Format	2	2.1	2-1	all	I like the overall format of this introductory section: a) a brief introductory paragraph that identifies the topic of the chapter and how it fits into the MARLAP process, b) an explicit but brief list of chapter objectives, c) comments about terminology used in the chapter, and d) a succinct overview of the chapter sections, with high-level cross-references if appropriate.
2414	111	JM	Technical	Organization	2	2.5	all		I think that the discussion of the DQO process would be much clearer to the reader if Appendix B (sections B1 to B3.9) were incorporated in its entirety into chapter 2. As it now stands, neither Appendix B nor Chapter 2 give the total picture, and the different numbering of steps in these two parts of the Manual adds to the confusion. In many cases, the text in Appendix B tends to explain the process better than does Chapter 2. Specific suggestions for merging the two are provided as separate comments. If there is some pressing reason that the two cannot be merged, then at a minimum there should be cross-references to appropriate sections of Appendix B sprinkled throughout Chapter 2 in order to tie the two together. In any case, Appendix Attachment B-1 is probably most appropriately left as an appendix in the manual.
2415	112	JM	Editorial	Style	2	2.1	2-2	31-33	Move the second sentence to the end of the paragraph. Delete the name of the referenced chapter; the chapter number alone is adequate.
2416	113	JM	Editorial	Grammar	2	2.1	2-2	31-41	Use the present tense instead of the future tense throughout this paragraph (I.e., delete the word "will")
2417	114	JM	Editorial	Style	2	2.1	2-2	42-48	This last paragraph seems out of place for a chapter introduction. It should be deleted or moved to merge with the introductory paragraph for section 2.3.3.
2418	115	JM	Editorial	Typo	2	2.1	2-2	44	Typo, should refer to Section 1.4.1, not 1.4.7
2419	116	JM	Editorial	Style	2	2.1	2-2	44-45	I suggest deleting the name of the referenced section and the chapter in which it occurs. The section number alone is adequate. This should be a global change throughout the document (I.e., citing no more than the chapter or section number for a cross-reference).
2420	117	JM	Editorial	Style	2	2.1	2-2	45-47	Delete the parentheses and replace the left-hand parentheses with the word "because".
2421	118	JM	Editorial	Style	2	2.2	2-2	49-92	Nicely written section, just the right level of detail, good pacing, effective mix of presentation styles (short paragraphs, bulleted lists, boxed example)
2422	119	SB	technical	terminology	2	2.2	2-3	71	"licensees" seems to imply that the party with the financial liability would always be a licensed entity, which is probably not the case in a lot of cases. Suggest broadening term to include "responsible parties" and other words to include those non-governmental organizations with a financial interest.
2423	120	JM	Editorial	Grammar	2	2.2	2-3	75	Insert comma after "stakeholders"
2424	121	JM	Editorial	Suggestion	2	2.2	2-3	78-79	The concept expressed in this first sentence should be included in the list of recommendations at the end of the chapter, e.g. "MARLAP recommends the collection of only those data needed to address the appropriate questions and support defensible decisions."
2425	122	JM	Editorial	Style	2	2.2	2-3	81	Define QC
2426	123	JM	Editorial	Grammar	2	2.2	2-3	84	Replace "is" with "are"
2427	124	JM	Editorial	Suggestion	2	2.3.1	2-4	104-105	The concept expressed in this first sentence should be included in the list of recommendations at the end of the chapter, e.g. "MARLAP recommends a graded approach in which the sophistication, the level of QC and oversight, and the resources applied be appropriate to the project."
2428	125	JM	Editorial	Typo	2	2.3.2	2-4	113-131	The titles of these ASTM references are slightly different from those listed in the reference section, e.g., "Guide" on line 118 but "Guidance" on line 745; "Characteristics" on line 123 but "Characterization" on line 748; the word "for" following "Guide" on lines 747, 738, and 743 but

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	Row	Source	Category	Classification	Chap	Section	Page	Line	Comment
									missing from lines 123, 128, and 131; and the location of the procedure number with respect to the title.
2429	126	JM	Editorial	Typo	2	2.3.2	2-5	139, 142	Need to indicate 2000a and 2000b to distinguish these two EPA references.
2430	127	JM	Editorial	Style	2	2.3.2	2-5	143	Acronym ACE used here; Chapter 4 uses "USACE"
2431	128	JM	Editorial	Typo	2	2.3.2	2-6	152	Need to specify either 2000a or 2000b to identify which EPA reference is meant here
2432	129	JM	Technical	Clarification	2	2.3.3	2-6	160	What is meant by the phrase, "the concern that requires streamlining"?
2433	130	JM	Technical	Suggestion	2	2.3.3	2-6	173-176	The concept expressed in this first sentence should be included in the list of recommendations at the end of the chapter, e.g. "MARLAP recommends the planning team strive for consensus among the stakeholders on the project planning elements."
2434	131	JM	Editorial	Style	2	2.3.3	2-6	176	Insert "only": "If only a cursory job..."
2435	132	SB	technical	suggestion	2	2.4.1	2-7	205	Shouldn't the planning team also include representatives of the parties paying for the analyses and potentially for remedial actions afterwards?
2436	133	JM	Editorial	Style	2	2.3.3	2-7	190-191	I suggest deleting the name of the referenced chapter. The chapter number alone is adequate.
2437	134	JM	Technical	Suggestion	2	2.4	2-7	194-195	The concept expressed in this second sentence should be included in the list of recommendations at the end of the chapter, e.g. "MARLAP recommends that the planning team consist of all of the parties who have a vested interest in, or who can influence, the outcome (stakeholders)."
2438	135	JM	Editorial	Grammar	2	2.4	2-7	195	Insert commas: "who have a vested interest in, or who can influence, the outcome"
2439	136	JM	Technical	Suggestion	2	2.4.1	2-7	204	At some place in this section, possibly even in the introductory sentence, mention that the graded approach applies to the team representation too, that the team might consist of just a couple people, extending up to a dozen or so, depending upon the magnitude of the problem and the complexity of the issues.
2440	137	JM	Technical	Suggestion	2	2.4.1	2-8	194, 199	The concept expressed in this sentence should be included in the list of recommendations at the end of the chapter, e.g. "MARLAP recommends that the planning team include operational and technical experts, including a radionanalytical specialist."
2441	138	JM	Technical	Suggestion	2	2.4.2	2-8	234	At some place in this section, mention that the role of the "radioanalytical specialist" need not be filled by a single person with a specific title but rather may be jointly covered by the expertise and experience of the other team members, e.g., an industrial hygienist, lab personnel, scientist, project manager.
2442	139	JM	Editorial	Typo	2	2.5	2-9	252	Typo in title for section 2.5: Directed
2443	140	JM	Technical	Suggestion	2	2.5	2-9	253-542	The process of developing DQOs as specific statements seems to fall through the cracks in that this task never get discussed explicitly, but just implicitly. It would help a lot to have some DQO examples, similar to the example of a decision rule given in section 2.5.3 on page 2-15.
2444	141	JM	Editorial	Style	2	2.5	2-9	263	Insert "(APSs)" at end of sentence.
2445	142	JM	Editorial	Style	2	2.5	2-10	276	Replace "lab" with "laboratory"
2446	143	JM	Editorial	Grammar	2	2.5	2-10	277	Insert comma after "design"
2447	144	JM	Technical	Suggestion	2	2.5	2-10	284-289	The concept expressed in these sentences should be included in the list of recommendations at the end of the chapter, e.g. "MARLAP recommends that the planning team ensure that it conducts the planning process in an iterative, rather than stepwise, fashion, with the objectives of more precisely defining the decisions and data needs as the planning progresses, and using new information to modify or change earlier decisions until the team has determined the most resource-effective approach to the problem."

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2448	145	JM	Editorial	Grammar	2	2.5	2-10	289	Hyphenate "resource-effective"
2449	146	JM	Technical	Format	2	2.5	2-10	Table 2.1	I really like this table's design and content as an effective summary of the planning process and the role of the radioanalytical specialist. Consider whether it might be appropriate to include in an Executive Summary.
2450	147	JM	Editorial	Style	2	2.5	2-10	Table 2.1	Row 1, Column 1: replace "State the problem" with "Define the problem" in order to match the title of section 2.5.1
2451	148	JM	Editorial	Grammar	2	2.5	2-10	Table 2.1	Row 1, Column 3, bullet 2, line 3: replace "is" with "are" ["the underlying data that are..."]
2452	149	JM	Editorial	Style	2	2.5	2-10	Table 2.1	Use a consistent format for the column entries--in Row 1, Column 4, reword bullets, e.g., "Problem defined with specificity," and "Identification of the..."
2453	150	JM	Editorial	Grammar	2	2.5	2-11	Table 2.1	Row 2a, Column 3, bullet 1, line 2: insert comma after "measured"
2454	151	JM	Editorial	Style	2	2.5	2-11	Table 2.1	Row 2a, Column 3, bullet 3, lines 2-3: Replace "Analytical Protocol Specifications" with "APSs"; the use of acronyms throughout this table is inconsistent (i.e., sometimes used, sometimes not)
2455	152	JM	Editorial	Grammar	2	2.5	2-11	Table 2.1	Row 2b, Column 2, last line: replace "is" with "are" ["if new data are needed"]
2456	153	JM	Editorial	Style	2	2.5	2-11	Table 2.1	Row 2b, Column 3, bullet 2: Is "alternate" the right word? Should it be "alternative," "additional", or "surrogate"?
2457	154	JM	Editorial	Grammar	2	2.5	2-11	Table 2.1	Row 2b, Column 4, bullet 4, line 1: delete premature period
2458	155	JM	Technical	Clarification	2	2.5	2-11	Table 2.1	Row 2c, Column 4, bullet 2: the meaning of "scale" here is not clear. How is the meaning of this bullet different from the one above it?
2459	156	JM	Technical	Clarification	2	2.5	2-11	Table 2.1	Row 3a, Column 1, bullet 3: The meaning of this bullet is not clear ("the scale of decision making"). Perhaps better to replace "scale" with "extent"?
2460	157	JM	Editorial	Style	2	2.5	2-11	Table 2.1	Row 3a, Column 3: make the format of these bullets consistent with other entries in this column: "Identify potentially..." and "Estimate measurement uncertainties..." Note that "uncertainties" should be plural here because "protocols" is plural.
2461	158	JM	Editorial	Grammar	2	2.5	2-11	Table 2.1	Row 3b, Column 3, bullet 2, line 4: Insert comma after "protocols" and insert "if" after "or": "protocols, or if the..."
2462	159	JM	Editorial	Style	2	2.5	2-11	Table 2.1	Row 3b, Column 4, bullet 2, line 1: Replace "Define" with "Definition of"
2463	160	JM	Technical	Style	2	2.5	2-12	342-542	Although I have lots of questions and suggested changes to these subsections, nevertheless I find them to be useful and to add value beyond the information presented in Table 2.1. The text doesn't duplicate the table entries but the two discussions support one another. The main inconsistency is that individual items in the subsections are sometimes discussed under different elements than where they appear in Table 2.1, as pointed out in some of my specific comments on these subsections.
2464	161	JM	Editorial	Style	2	2.5.1	2-12	347	Replace ""making a decision" with "needing a decision to be made"
2465	162	JM	Technical	Clarification	2	2.5	2-12	Table 2.1	Need to indicate which element(s) result in DQOs as the output. As it is now, DQOs are not mentioned in this table until the last column of the last element, so that they appear to spring from nowhere.
2466	163	JM	Editorial	Style	2	2.5	2-12	Table 2.1	Row 4, Column 1: Use lower case for all words but the first one, to match format of the other rows in this column.
2467	164	JM	Editorial	Style	2	2.5	2-12	Table 2.1	Row 4, Column 3, bullet 3, line 1: would read more smoothly if "Method requirement" were replaced by "Methods required"
2468	165	JM	Editorial	Style	2	2.5	2-12	Table 2.1	Row 4, Column 3, bullet 6, line 1: replace "quality control" with "QC"
2469	166	JM	Editorial	Style	2	2.5	2-12	Table 2.1	Row 4, Column 3, bullet 9, line 2: Replace "Analytical Protocol Specifications" with "APSs"

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	Row	Source	Category	Classification	Chap	Section	Page	Line	Comment
2470	167	JM	Editorial	Style	2	2.5	2-12	Table 2.1	Row 4, Column 4, bullet 3: Replace "Analytical Protocol Specifications" with "APSS"
2471	168	JM	technical	Organization	2	2.5.1	2-12		Merge Appendix section B3.1 with section 2.5.1
2472	169	JM	Editorial	Typo	2	2.5.1	2-13	354	Replace "projects's" with "project's"
2473	170	SB	technical	suggestion	2	2.5.2	2-13	364 ff, esp 376 ff	Perhaps it should be clearer that not all radiochemical analyses are undertaken with a specific decision in mind, let alone a unique action level that will drive the decision. MARLAP works better if there is, but it has much to contribute even if there isn't, as when some general characterization work is undertaken. This issue is briefly discussed on p. 7-24, lines 694 ff; a cross-reference could be added here.
2474	171	JM	Technical	Terminology	2	2.5.2	2-13	369	"operation" is somewhat confusing here as a phase of site closure. Perhaps replace it with "cleanup operation"
2475	172	JM	Technical	Organization	2	2.5.2.1	2-13	375	Here, actions levels are discussed under "Identify the Decision." However, in Table 2.1, action levels are assigned to Row 2b, "Identify inputs to the decision," which is section 2.5.2.3 in the text.
2476	173	JM	Editorial	Grammar	2	2.5.2.1	2-13	378	Replace "criteria" with "criterion" to match rest of the list in this sentence
2477	174	JM	Editorial	Style	2	2.5.2.1	2-13	379	Replace "the type of medium" with "a specific type of medium"
2478	175	JM	Technical	Organization	2	2.5.2	2-13		Merge Appendix section B3.2 with section 2.5.2
2479	176	JM	Editorial	Style	2	2.5.2.1	2-14	388	Delete "probably". Insert hyphen in "radionuclide-specific"
2480	177	JM	Editorial	Style	2	2.5.2.1	2-14	389	Insert "(MCL)" after "Maximum Contaminant Level" (and add it to the list of acronyms)
2481	178	JM	Technical	Clarification	2	2.5.2.1	2-14	392	The logic of this sentence is not quite clear as written because the information in the parentheses is not an example of reasons that the no action alternative is overlooked. Reword this line by inserting connecting words: "overlooked but may be the optimal course of action (e.g. no technology...)"
2482	179	JM	Editorial	Style	2	2.5.2.1	2-14	393	Delete "of the directed planning process"
2483	180	JM	Editorial	Style	2	2.5.2.1	2-14	398	Delete "of Chapter 3"
2484	181	JM	Editorial	Style	2	2.5.2.1	2-14	400	Replace "Analytical Protocol Specifications" with "APSS"
2485	182	JM	Editorial	Terminology	2	2.5.2.2	2-14	401	Replace "Scale" with "Boundaries" to match entry in Row 2c of Table 2.1
2486	183	JM	Editorial	Grammar	2	2.5.2.2	2-14	402	Reverse order of words: "team should define clearly..."
2487	184	JM	Editorial	Terminology	2	2.5.2.2	2-14	403-404	Replace "The scale" with "The spatial and temporal boundaries" and delete "based on the spatial and temporal boundaries"
2488	185	JM	Editorial	Grammar	2	2.5.2.2	2-14	407	Insert comma after "shape"
2489	186	JM	Editorial	Style	2	2.5.2.2	2-14	410-415	The topic of this paragraph and the level of detail in it seem inappropriate for this overview discussion. I suggest that it be deleted.
2490	187	JM	Editorial	Style	2	2.5.2.3	2-15	416	Delete "and Boundaries" to match entry in Row 2b of Table 2.1. Note that 2.5.2.2 and 2.5.2.3 are reversed from the order in which these elements appear in Table 2.1
2491	188	JM	Editorial	Style	2	2.5.2.3	2-15	416-423	The distinction between the discussions in sections 2.5.2.2 and 2.5.2.3 is blurry; these subsections overlap with one another.
2492	189	JM	Technical	Suggestion	2	2.5.2.3	2-15	418	To give another common example of a statistical parameter, insert "95th percentile concentration" after "mean"
2493	190	JM	Editorial	Style	2	2.5.2.3	2-15	419-422	Delete the first sentence ("Typically, the study boundaries...") because this topic was discussed in section 2.5.2.2. Move the second sentence ("Changing conditions...") to section 2.5.2.2.
2494	191	JM	Editorial	Style	2	2.5.2.3	2-15	423	Delete "(e.g., mean concentration)"; repetitive of its appearance on line 418

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	Row	Source	Category	Classification	Chap	Section	Page	Line	Comment
2495	192	JM	Technical	Style	2	2.5.2.3	2-15	423	Discussion of the "appropriate action level" here blurs the distinction between the discussions in sections 2.5.2.1 and 2.5.2.3 because action level was discussed extensively in section 2.5.2.1.
2496	193	JM	Editorial	Style	2	2.5.2.3	2-15	423	Insert "statistical" after "appropriate"
2497	194	JM	Editorial	Style	2	2.5.2.4	2-15	425-426	The second half of this sentence would read more smoothly if it were revised to read, "...a list of the specific data requirements (number, type, quality)."
2498	195	JM	Technical	Clarification	2	2.5.2.4	2-15	426	Explain why an estimate of the expected variability is needed. E.g., "because the uncertainty estimate is used to define the gray region and factors into the determination of decision error rates."
2499	196	JM	Technical	Clarification	2	2.5.3	2-15	438	Should a third item be added to the list of what is included in the decision rule? "(3) the decision that would be made, or the action that would be taken, based on the different possible outcomes of the analytical data."
2500	197	JM	Technical	Format	2	2.5.3	2-15	439	I very much appreciate the inclusion of an example at this point in the discussion, and suggest that a couple other examples of decision rules be given in this same box for other common situations, e.g., using drinking water standards and waste disposal path determination.
2501	198	JM	Technical	Clarification	2	2.5.3	2-15	442	Is the word "technical" appropriate here, or should it be deleted? Same comment for its use in line 444. I don't understand its purpose in this context. Perhaps you mean "alternative measurement approaches or protocols", which is used on line 462?
2502	199	JM	Editorial	Grammar	2	2.5.3	2-15	444	Change the colon to a semi-colon
2503	200	JM	Editorial	Style	2	2.5.3	2-15	444	Replace "will" with "must"
2504	201	JM	Technical	Clarification	2	2.5.2.4	2-15		Create new section about a feedback loop at this point by moving Appendix Section B3.5 to chapter 2, either creating new 2.5.2.5 or renaming as new 2.5.3
2505	202	JM	Technical	Organization	2	2.5.2.3	2-15		Merge Appendix section B3.3 and B3.4 with section 2.5.2.3 (or split 2.5.2.3 into two sections, 2.5.2.3 and new 2.5.2.4)
2506	203	JM	Technical	Organization	2	2.5.3	2-15		Merge Appendix section B3.6 and B3.7 with section 2.5.3 (or split 2.5.3 into two sections)
2507	204	JM	Technical	Style	2	2.5.3	2-16	445	Insert after "radionuclide of interest": "with sufficient confidence at the action level"
2508	205	JM	Editorial	Style	2	2.5.3	2-16	445-446	I suggest deleting the name of the referenced chapter. The chapter number alone is adequate.
2509	206	JM	Editorial	Typo	2	2.5.3	2-16	457	Replace "decisions" with "decision"
2510	207	JM	Editorial	Typo	2	2.5.3	2-16	458	Capitalize the first letter in "See"
2511	208	JM	Editorial	Terminology	2	2.5.3	2-16	460	Should it be "maker's" instead of "makers' "? I've seen it both ways in this chapter (e.g., maker in row 1, column 4 of Table 2.1 and on line 722)
2512	209	JM	Technical	Terminology	2	2.5.3	2-16	464	Replace "Type I or Type II" with "decision"
2513	210	JM	Technical	Clarification	2	2.5.3	2-16	466-468	I don't understand the intent of the word "attempts" here. In fact, the first and last halves of this sentence don't make sense together. Is some text missing?
2514	211	JM	Technical	Clarification	2	2.5.4	2-17	474	Replace the last part of the sentence so that it reads "between the radioanalytical specialist and laboratory and field personnel."
2515	212	JM	Technical	Clarification	2	2.5.4	2-17	475	Is the "analysis design" the same as the "data collection design" on line 473? If so, then a single term should be used.
2516	213	JM	Editorial	Style	2	2.5.4	2-17	476	Insert "and" after "number of samples required"
2517	214	JM	Editorial	Style	2	2.5.4	2-17	476	Replace "Analytical Protocol Specifications" with "APSs"
2518	215	JM	Editorial	Style	2	2.5.4	2-17	477-479	Replace the long parenthetical reference with a shortened version: "(see sections 2.5.4.1 and 2.5.4.2

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2519	216	JM	Technical	Clarification	2	2.5.4	2-17	483-498 below)" The rest of section 2.5.4 does not follow an obvious logical progression, in terms of topics and level of discussion. The boundaries between the first two paragraphs (lines 483-498) and sections 2.5.4.1 and 2.5.4.2 are fuzzy. I suggest that the details discussed in these two paragraphs (e.g., starting with line 487) be moved into the subsections.
2520	217	JM	Editorial	Style	2	2.5.4	2-17	496 The sentence would read more smoothly by shifting the location of "which" and deleting the comma: "to identify which portions of the analytical protocols potentially have..."
2521	218	JM	Editorial	Organization	2	2.5.4	2-17	Merge Appendix section B3.8 with section 2.5.4
2522	219	JM	Editorial	Style	2	2.5.4.1	2-18	507-508 I suggest deleting the name of the referenced chapter. The chapter number alone is adequate.
2523	220	JM	Editorial	Style	2	2.5.4.2	2-18	526 Replace "lab" with "laboratory"
2524	221	JM	Technical	Clarification	2	2.5.4.2	2-18	527 I don't understand what is meant by "collocated sample precision"
2525	222	JM	Editorial	Terminology	2	2.5.4.2	2-18	533 Should "select" be "selected"?
2526	223	JM	Editorial	Grammar	2	2.5.4.2	2-18	535 Insert apostrophe in "analyte's"
2527	224	JM	Editorial	Terminology	2	2.5.4.2	2-19	539 Should "decisions" be "criteria"?
2528	225	JM	Editorial	Style	2	2.5.4.2	2-19	542 Replace "Appendix D, Section 2.7" with "Appendix Section D2.7"
2529	226	JM	Editorial	Style	2	2.6	2-19	544-545 Replace "their priority of concerns" with "its prioritized concerns"
2530	227	JM	Editorial	Grammar	2	2.6	2-19	547 Replace "They have" with "It has"
2531	228	JM	Technical	Clarification	2	2.6	2-19	556 Should the order be reversed to "a decision and an action"?
2532	229	JM	Editorial	Style	2	2.6.1	2-20	569-570 Replace "Analytical Protocol Specifications" with "APSs"
2533	230	JM	Editorial	Grammar	2	2.6.1	2-20	571 Insert comma after "data"
2534	231	JM	Editorial	Style	2	2.6.1	2-20	582 Replace "Analytical Protocol Specifications" with "APSs" in 2 places on this line
2535	232	JM	Editorial	Style	2	2.6.1	2-20	585-586 Replace "Analytical Protocol Specifications" with "APSs"
2536	233	JM	Editorial	Style	2	2.6.1	2-20	587-588 I suggest deleting the name of the referenced chapter. The chapter number alone is adequate.
2537	234	JM	Editorial	Style	2	2.6.1	2-20	589 Replace "Analytical Protocol Specifications" with "APSs"
2538	235	JM	Technical	Terminology	2	2.6.2	2-21	601 I recommend starting this paragraph with a simple definition of what chain of custody means.
2539	236	JM	Technical	Style	2	2.6.2	2-21	604-605 Delete this sentence about the data report; the contents of the data report are irrelevant to the discussion of the COC. Also, the phrase "not all of which can be listed here" is confusing and ambiguous because this paragraph doesn't list anything nor does it tell you whether this information is listed elsewhere in the manual or not at all in the Manual.
2540	237	JM	Editorial	Style	2	2.6.2	2-21	605 Replace "lab" with "laboratory"
2541	238	JM	Technical	Terminology	2	2.6.2	2-21	605 The use of "component" here is confusing. Replace with "personnel"?
2542	239	JM	Technical	Suggestion	2	2.7.1	2-21	624-627 The concept expressed in this sentence should be included in the list of recommendations at the end of the chapter, e.g. "MARLAP recommends the use of a formal change control process if updates of the original plans are found to be needed in response to new information on field conditions or other situations."
2543	240	JM	Editorial	Style	2	2.7.1	2-22	602-603 Replace "Analytical Protocol Specifications" with "APSs"
2544	241	JM	Editorial	Style	2	2.7.1	2-22	633 Insert "statistical", i.e. "the statistical parameter"
2545	242	JM	Technical	Clarification	2	2.7.1	2-22	636 The meaning of this bullet is not completely clear. Perhaps reword the last part: "for evaluating the usability of the data"?

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	Row	Source	Category	Classification	Chap	Section	Page	Line	Comment
2546	243	JM	Editorial	Style	2	2.7.1	2-22	642-643	I suggest deleting the name of the referenced chapter and appendix. The chapter number and appendix letter alone are adequate.
2547	244	JM	Editorial	Grammar	2	2.7.2	2-22	655	Delete comma after "agreement"
2548	245	JM	Technical	Suggestion	2	2.7.2	2-22	658-659	The concept expressed in this sentence should be included in the list of recommendations at the end of the chapter, e.g. "MARLAP recommends that a Statement of Work be developed even if a contract is not involved, for example, when an agency employs one of its own laboratories."
2549	246	JM	Editorial	Style	2	2.7.2	2-22	659	Replace "labs" with "laboratories"
2550	247	JM	Editorial	Grammar	2	2.7.3	2-23	678	Delete comma after "as well as"
2551	248	JM	Technical	Style	2	2.7.4	2-23	693	What does "it" refer to? Perhaps reword the second half of this sentence as: "while DQA considers the data set as a whole, including the sampling and analytical protocols used to produce them, during the assessment of data quality"
2552	249	JM	Technical	Clarification	2	2.7.4.1	2-24	704	Clarify parenthetical note by expanding it: "(as prescribed by the MQOs)"
2553	250	JM	Editorial	Style	2	2.7.4.1	2-24	709-710	I suggest deleting the name of the chapter. The chapter number is sufficient.
2554	251	JM	Editorial	Style	2	2.7.4.2	2-24	714-715	I suggest deleting the name of the chapter. The chapter number is sufficient.
2555	252	JM	Editorial	Style	2	2.7.4.2	2-24	716	Delete "planning process statements of the"
2556	253	JM	Technical	Style	2	2.7.4.2	2-24	716	Reword last part: "...MQOs as the basis for assessing whether the obtained data..."
2557	254	JM	Editorial	Style	2	2.7.4.3	2-24	723	Use lower case for "DQA process" because it is lower case elsewhere in this paragraph
2558	255	JM	Editorial	Style	2	2.7.4.3	2-24	724	I suggest deleting the name of the chapter. The chapter number is sufficient.
2559	256	JM	Editorial	Style	2	2.7.4.3	2-24	725	Insert "the" in "the DQA process"
2560	257	JM	Technical	Suggestion	2	End	2-25	728-733	This list of succinct recommendations is a great idea and should also mke it easier to develop an Executive Summary. Consider making this list a separate section and expanding it to be more inclusive of other key points in this chapter (as suggested in separate comments). Also I think it would be less distracting if the phrase "MARLAP recommends" were not used to introduce every recommendation, but instead was used as the introductory sentence to this compilation, e.g., "MARLAP recommends the following actions during the planning phase when a decision is to be based on the collection and evaluation of radiological data:"
2561	258	JM	Technical	Suggestion	2	End	2-25	729	I suggest that this recommendation be expanded to contain a bit more information, e.g., "directed project planning process in order to provide logic and framework for defining the data needed to support an informed decision for the project."
2562	259	JM	Technical	Suggestion	2	End	2-25	730-731	I suggest rewriting this recommendation to be more general: "MARLAP recommends that technical experts, and particularly radioanalytical specialists, be a part of a multi-disciplinary project planning team that includes other stakeholders as well."
2563	260	JM	Technical	Suggestion	2	End	2-25	732-733	I suggest separating this recommendation into two: (1) "MARLAP recommends that the planning process rationale be documented in project plan documents." and (2) "MARLAP recommends that the outputs from the planning process be integrated with the analytical SOW and data assessment plans (e.g., for data validation, verification and quality assessment)."
2564	261	JM	Editorial	Typo	2	2.8	2-25	752	Couldn't get to the web site using this address. Replace "/filesfin.htm" with "/obtain.htm"
2565	262	JM	Editorial	Typo	2	2.8	2-26	762, 767	Need to indicate 2000a and 2000b to distinguish these two EPA references.
2566	263	JM	Editorial	Commentary	2	2.8	2-26	765-766	I don't remember coming across a citation to this reference in this chapter, although I would have expected to see it cited in section 2.7.4.1

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	Row	Source	Category	Classification	Chap	Section	Page	Line	Comment
2567	264	JL	technical	commentary	2	2	All		Where can you find a radioanalytical specialist? I think that they are absolutely essential throughout planning, implementation, and assessment. But the skill set for a radioanalytical specialist is different than for the generic "radiation physicist" that we have in our job specs. I wonder if it would be useful for small licensees or small regulatory programs to have a job spec or a SOW to hire a radioanalytical specialist to help with writing the real SOW for the project, evaluation of bids, and assessment of the data.
2568	265	SB	technical	suggestion	2	2.2	2-2		This section and others seem to suggest that radiological laboratory analytical data are only required to help solve problems or to conduct projects. The ongoing activities that utilize these data such as effluent monitoring and environmental surveillance activities at all of the major nuclear power, production and research sites should also be recognized as consumers of radiological laboratory analytical data .
2569	266	BB	technical	commentary	2	2.3.1	2-4	103-109	The limited number of references to a "graded approach" (e.g., p. 2-4, lines 103-109, Section 4.5.3, and the first recommendation on p. 4-18) do not provide guidance that is clear or complete about when to do what.
2570	267	JM	Editorial	Grammar	3	3.1	3-1	14	Replace "only should contain" with "should contain only"
2571	268	JM	Editorial	Style	3	3.1	3-1	16-19	Delete the last two sentences because they repeat concepts already stated in the previous paragraph.
2572	269	JM	Editorial	Style	3	3.1	3-1	20	Delete the word "key" here.
2573	270	JM	Editorial	Style	3	3.1	3-1	20-23	Could make this paragraph more succinct with no loss of relevant information by the following changes. Replace lines 21-23 to read as follows: "this chapter provides a list of some common key analytical issues as well as a framework and broad base of information..."
2574	271	JM	Editorial	Style	3	3.2	3-2	40	Replace "The analytical process as described in Chapter 1 includes all activities, starting with" with "The analytical process, as defined in Section 1.4.4 and illustrated in Figure 3.1, starts with"
2575	272	JM	Editorial	Grammar	3	3.2	3-2	42	replace semi-colons with commas
2576	273	JM	Editorial	Style	3	3.2	3-2	44	Delete sentence "Figure 3.1..."
2577	274	JM	Editorial	Grammar	3	3.2	3-2	48	Insert comma: "planning issues, depending"
2578	275	JM	Editorial	Style	3	3.3	3-2	56	Delete "of Chapter 6" because this is self-evident from the section number
2579	276	JM	Technical	Clarification	3	3.3	3-2	57	Reword this reference: "discusses how some of these planning issues influence the method selection process"
2580	277	JJ	technical	suggestion	3	3.3.1	3-4	75	This section defines the target analyte list in terms of radionuclides. The statement should be broadened to include chemical contaminants as well since the planning issues are applicable to the whole spectrum of constituents of concern.
2581	278	JM	Editorial	Style	3	3.3.1	3-4	73-74	Delete "that should be addressed...planning team"
2582	279	JM	Technical	Style	3	3.3.1	3-4	75	Insert a new sentence as a note? "(Note that the target analyte list may also include nonradioactive hazardous constituents, which could also influence the analytical protocols, including sample collection and waste disposal issues. However, although this issue would probably be dealt with by the same planning team, discussion of it is outside the scope of MARLAP.)"
2583	280	JJ	technical	suggestion	3	3.3.1	3-5	102 ff	This paragraph should note that under certain circumstances, a properly designed characterization survey can be used as the final status survey for areas found to be unimpacted or at contaminant concentration levels well below the DCGLs.
2584	281	JM	Editorial	Style	3	3.3.1	3-5	102-106	Shorten the first three sentences to two sentences by re-ordering them. Start off with "A fourth source of information...study." The next sentence would then read, "This preliminary analyses may be necessary if there are little or no historical data..inadequate quality."

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	Row	Source	Category	Classification	Chap	Section	Page	Line	Comment
2585	282	JM	Editorial	Style	3	3.3.1	3-5	112	Line 113 belongs in the same paragraph as the sentence that precedes it ("Gross alpha...studies.") Either append it to the preceding paragraph, or use the preceding sentence as the start of a new paragraph.
2586	283	JM	Editorial	Style	3	3.3.1	3-5	116	Reword the beginning of this bullet as "Ability to detect the presence" in order to match the format of the preceding bullets
2587	284	JM	Technical	Style	3	3.3.1	3-5	122	I appreciate the explicit description of the output from this discussion.
2588	285	JM	Editorial	Style	3	3.3.2	3-6	131-132	On line 131, delete "and". On line 132, insert a new item so that the beginning of this line reads: "studies, and preliminary survey or characterization results, if available"
2589	286	JM	Editorial	Style	3	3.3.2	3-6	132-133	It would be less distracting to the reader if the phrase "concentration range for each analyte" was shortened to "range", and if the phrase "fairly large concentration range for the radionuclide of concern" were shortened to "fairly large range". No ambiguity would result because the introductory sentence makes it clear what range is being discussed.
2590	287	JM	Editorial	Style	3	3.3.2	3-6	134	Delete "concentration"
2591	288	JM	Editorial	Style	3	3.3.2	3-6	135-136	The following would read more smoothly: "for the protocol selection process, thereby eliminating any analytical protocols that cannot accommodate this need."
2592	289	JM	Editorial	Style	3	3.3.2	3-6	136-141	Write these sentences more succinctly as follows: "In addition, knowledge of the expected concentrations ranges for all of the radionuclides of concern can be used to identify possible chemical or spectral interferences that might lead to the elimination of some of the alternative analytical protocols."
2593	290	JM	Editorial	Style	3	3.3.2	3-6	142-143	Delete the second occurrence of "the expected concentration range of". Replace line 143 with the following "for any constituent with the potential for causing chemical or radiological interference."
2594	291	JM	Editorial	Style	3	3.3.3	3-6	146	Delete "For many projects" so that the sentence starts with "Typical matrices" Delete "may"
2595	292	JM	Technical	Suggestion	3	3.3.3	3-6	147	Insert after "air particulates": "radioactive gases" [referring to radon, tritium, iodine]
2596	293	JM	Editorial	Typo	3	3.3.3	3-6	158	Should refer to Section 3.4, not 3.5
2597	294	JM	Editorial	Style	3	3.3.3	3-6	159	Delete "of Chapter 6"
2598	295	JM	Editorial	Style	3	3.3.3	3-7	160	Delete "any"
2599	296	JM	Editorial	Style	3	3.3.3	3-7	160-161	Shorten the last part of this sentence to read, "information on their chemical and physical characteristics and on possible hazards associated with them."
2600	297	JM	Editorial	Style	3	3.3.3	3-7	162	Delete "As previously noted,"
2601	298	JM	Editorial	Style	3	3.3.3	3-7	164	Replace "lists" with "list"
2602	299	JM	Technical	Suggestion	3	3.3.4	3-7	165	Because there could be more than two radionuclides of concern, replace "Between" with "Among" in this section title. Consider replacing "Relationship" with "Correlation" here and throughout this section.
2603	300	JM	Technical	Terminology	3	3.3.4	3-7	166	Would "surrogate" or "indicator" be a more appropriate word than "alternative"?
2604	301	JM	Editorial	Style	3	3.3.4	3-7	169	Delete "to measure"
2605	302	JM	Editorial	Style	3	3.3.4	3-7	170	Insert "that" or "the one" in the phrase: "One of the best known and easiest relationships to establish is that between" or " the one between"
2606	303	JM	Technical	Terminology	3	3.3.4	3-7	188-189	Same question as for line 166: Would "surrogate" or "indicator" be a more appropriate word than "alternative"?
2607	304	JM	Editorial	Style	3	3.3.4	3-8	192-193	Shorten by stating: "A list of known or potential radionuclide relationships, based upon parent-progeny relationships, previous study results, or process knowledge."

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2608	305	JM	Editorial	Style	3	3.3.6	3-8	210-211	Replace "The list should" with "The list is likely to"
2609	306	JM	Editorial	Style	3	3.3.6	3-8	214-216	Shorten these two sentences to read as follows: "Where this is significant uncertainty about the presence or absence of specific radionuclides, the most conservative approach is to leave them on the analyte list, even when there is only..."
2610	307	JM	Editorial	Style	3	3.3.6	3-8	221	Replace "provides" with "results in a list containing"
2611	308	JM	Editorial	Style	3	3.3.6	3-8	228	Provide cross-reference to sections 2.5 or 2.6 for discussing DQOs as an output
2612	309	JJ	technical	suggestion	3	3.3.7	3-9	240	A paragraph defining the "gray region" here would be helpful for readers who are not familiar with MARSSIM (or have short memories). The single statement in this paragraph and the references to the appendices are not really sufficient to allow the reader to understand the MQOs.
2613	310	SB	technical	suggestion	3	3.3.7	3-9	243	Suggest inserting "relatively" before "high decision error rate". If the LBGR allows a 5% type II error, is 6% really "high"?
2614	311	JM	Editorial	Style	3	3.3.7	3-9	235	Insert "(MQOs)" at end of sentence.
2615	312	JM	Editorial	Style	3	3.3.7	3-10	266	Move the last sentence to second place, following the italicized first sentence.
2616	313	JM	Editorial	Style	3	3.3.7	3-10	272-273	Replace the second occurrence of "the method performance characteristics" with "them"
2617	314	JM	Editorial	Grammar	3	3.3.7	3-10	280	Replace both occurrences of "since" with "because"
2618	315	JM	Editorial	Style	3	3.3.7	3-11	291-294	Delete this paragraph.
2619	316	JM	Technical	Organization	3	3.3.7.1	3-11	295-442	A lot of the same material is covered in section 6.5.5, but there are no cross-references between the two to link them together. Rather than treating the topic in full in both sections, the verbiage and overlap should be minimized by one of three approaches: (1) merge Sections 3.3.7.1 and 6.5.5 together in one chapter, (2) provide the bulk of the discussion in one chapter, with a highly summarized version in the other, with cross-references to the fuller discussion, or (3) establish a clear distinction between the scope and audience of each section, winnow out the parts that are not relevant for the particular chapter, and insert cross-references into both versions where appropriate.
2620	317	JM	Technical	Clarification	3	3.3.7.1	3-12	328	Following the symbol del, insert "and is a function of the action level, background level, and adopted decision error rates"
2621	318	JM	Editorial	Style	3	3.3.7.1	3-12	328	Replace reference to "Appendix B" with "Appendix Attachment B-1"
2622	319	JM	Technical	Style	3	3.3.7.1	3-12	339-345	Thank you for providing such a clear example!
2623	320	JM	Editorial	Suggestion	3	3.3.7.1	3-12	352, 354	It would be more user-friendly if more distinctly different formats could be used for the subheadings and the Output paragraphs.
2624	321	JM	Editorial	Suggestion	3	3.3.7.1	3-13	364	Italicize or underline "individual items or samples" to emphasize the distinction between this paragraph and the one that starts on line 376
2625	322	JM	Technical	Clarification	3	3.3.7.1	3-13	374	Footnote 1: what does it mean in English? Provide a cross-reference.
2626	323	JM	Editorial	Style	3	3.3.7.1	3-13	374	Insert "(MDC)" after "concentration"
2627	324	SB	editorial	commentary	3	3.3.7.1	3-13	Footnote	Footnote 1: Don't think beta has been defined near this point.
2628	325	SB	technical	clarification	3	3.3.7.1	3-14	385	How near to zero should the LBGR be? Suggest you delete "or near" unless you define "near".
2629	326	JM	Editorial	Suggestion	3	3.3.7.1	3-14	376	Italicize or underline "sampled population" to emphasize the distinction between this paragraph and the one that started on line 364
2630	327	JM	Editorial	Style	3	3.3.7.1	3-14	386	Insert "(MQC)" after "concentration"
2631	328	JM	Editorial	Grammar	3	3.3.7.1	3-14	387	Insert comma after ""gray region"
2632	329	JM	Editorial	Grammar	3	3.3.7.1	3-14	389	Replace "since" with "because"

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2633	330	JM	Editorial	Grammar	3	3.3.7.1	3-14	393	Insert comma after ""example"
2634	331	JM	Editorial	Style	3	3.3.7.1	3-14	395-396	Delete "this method performance characteristic..important method parameter. And last..."
2635	332	JM	Technical	Style	3	3.3.7.1	3-14	396	Replace "overemphasis on establishing" (which does not sound quite right) with "establishment of"
2636	333	JM	Technical	Style	3	3.3.7.1	3-14	399-402	These two sentences are so similar in wording that it takes a couple readings to note the differences. I suggest making the distinction more clear by rewording it as follows: "MQOs for each analyte: (a) expressed as MQCs if the lower bound of the gray region is at or near zero and decisions are to be made about a sample population; and (b) expressed as MDCs if the lower bound of the gray region is zero, and decisions are to be made about individual items or samples." Note the reworded version is also stated as an item, not in sentence form, to match the format of the other output statements in this section.
2637	334	SB	editorial	suggestion	3	3.3.7.1	3-15	423	Suggest adding "and radioactive" between "chemical" and "constituents".
2638	335	JM	Editorial	Typo	3	3.3.7.1	3-15	406	Typo? Replace "activity" with "analyte"
2639	336	JM	Editorial	Grammar	3	3.3.7.1	3-15	410	Replace "since" with "because"
2640	337	JM	Editorial	Style	3	3.3.7.1	3-15	413	Insert word: "This precaution"
2641	338	JM	Editorial	Style	3	3.3.7.1	3-15	413	Replace "prevent" with "minimize the potential for"
2642	339	JM	Editorial	Style	3	3.3.7.1	3-15	418	Delete the second occurrence of "the concentration of" in this sentence
2643	340	JM	Editorial	Style	3	3.3.7.1	3-15	421-425	This sentence would read more smoothly by rewording it: "The importance of this characteristic is evaluated by the radioanalytical specialist, based upon information about the expected concentration range of the analytes of concern as well as other chemical constituents that may be present and the chemical and physical characteristics of the matrices (sections 3.3.2 and 3.3.3)."
2644	341	JM	Editorial	Style	3	3.3.7.1	3-15	434-438	This sentence would read more smoothly by rewording it: "The importance of this characteristic is evaluated by the radioanalytical specialist, based upon detailed information about the chemical and physical characteristics of the sample. If important, then an MOO should be developed for it, and may require performance data demonstrating..."
2645	342	JM	Editorial	Reference	3	3.3.7.1	3-16	440	Insert proper reference citation after AOAC: "(Youder and Steiner, 1975)"
2646	343	JM	Technical	Clarification	3	3.3.7.3	3-16	460	Does this mean that a result of 0.02 +/- 0.02 would be rejected as not meeting the MQO, even though it is below the action level with a high degree of certainty?
2647	344	JM	Technical	Clarification	3	3.3.7.3	3-16	466	I don't think that "coverage factor" has been defined yet at this point, at least not in chapter 3. Provide cross-reference.
2648	345	JJ	technical	commentary	3	3.3.7.3	3-17	476	The example did not make sense to me. It's confusing and needs to be reviewed to make sure it accurately states the problem and the answer.
2649	346	JM	technical	typo	3	3.3.7.3	3-17	487	I think 1.50 Bq/g is a typo, and that it should be "0.150 Bq/g" to agree with line 479
2650	347	JM	Editorial	Style	3	3.3.8	3-17	495	Replace "determine" with "specify"
2651	348	JM	Technical	Clarification	3	3.3.8	3-17	496	Can you give an example of how the specification of analyses to be performed could limit the analysis options for the lab, if this constraint does not mean that a specific protocol or method has to be used? If I am understanding correctly, an example would be the following: "The analyte of concern is total uranium, but the team decides that a gross alpha measurement would be an acceptable alternate analysis and therefore specifies that analysis." But the text on lines 498-501 seems to say this example is not right either. So I'm lost here.
2652	349	JM	Editorial	Style	3	3.3.8	3-17	498	Delete second occurrence of "analytical" on this line.
2653	350	JM	Editorial	Style	3	3.3.8	3-18	501-504	Shorten this discussion after "239Pu in soil, etc." by replacing it with the following: "The project

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2654	351	JM	Technical	Terminology	3	3.3.8	3-18	508	planning team may decide to eliminate some analyses from consideration based on information obtained, such as the absence of..." Should "analyses" be replaced by "methods" here? Oif not, then I'm still lost as to the distinction between these two terms.
2655	352	JM	Editorial	Style	3	3.3.8	3-18	522	Replace "analysis" with "analytical"
2656	353	JM	Technical	Organization	3	3.3.8.1	3-18	523-557	Delete sections 3.3.8.1 to 3.3.8.3, and direct the reader back to 3.3.1 (lines 111-121) and/or to appropriate sections of Part II.
2657	354	JM	Technical	Terminology	3	3.3.9	3-19	560	Replace "determined" with "specified" and insert adjective "along with the associated sample matrices"
2658	355	JM	Editorial	Style	3	3.3.9	3-20	568	Insert new beginning to this sentence, as follow: "Assuming that a method is not prescribed by the applicable regulations, then there are a number of sources...."
2659	356	JM	Editorial	Typo	3	3.3.12	3-22	638	Typo: "parentheses" (I.e., plural)
2660	357	JM	Editorial	Style	3	3.4	3-22	646-653	Replace these 8 lines with the following: "...types of projects, as summarized in Table 3.1." Everything else is either extraneous, repetitious, self-evident from the table, or duplicates text in the subsections.
2661	358	JM	Technical	Clarification	3	3.4	3-23	654	Insert "Common" at the beginning of the caption for Table 3.1
2662	359	JM	Editorial	Grammar	3	3.4	3-23	665-666	Replace semi-colons with commas
2663	360	JM	Editorial	Style	3	3.4	3-23	666-667	Delete sentence "In general, most solid samples...in the laboratory."
2664	361	JM	Technical	Suggestion	3	3.4	3-23	667-668	Replace beginning of sentence: "Some solid samples may require preservation..to prevent sample degradation orloss of water and other volatiles." This is true for some soils and sediments as well as for biota.
2665	362	JM	Editorial	Style	3	3.4	3-23	673-679	Delete these cross-references here, and put them in Table 3.1, Column 3. For example, list the first couple potential key issues in this column as: "Container type and material (Chapter 10); Sample presevation (Chapter 10)", etc.
2666	363	JM	Editorial	Style	3	3.4	3-23	Table 3.1	Row for liquids, column 2. Replace last item with "Order is which sample is filtered and preserved"
2667	364	SB	technical	suggestion	3	3.4.1.2	3-24	691 ff	See comment for page 10-30, line 950 ff, about removing vegetative matter from soil samples
2668	365	JM	Editorial	Style	3	3.4.1.2	3-24	700-701	The sentence would read more smoothly as follows: "For soil samples, extraneous material to be removed, weighed, and then stored at the laboratory could include rocks of a certain sieve size, plant matter, debris, etc."
2669	366	SB	editorial	suggestion	3	3.4.2	3-25	708-719	Here is a place where another cross-reference could be added. The team talks later (I don't remember where) about the difference in filtration requirements between raw and finished water sampling.
2670	367	JM	Editorial	Style	3	3.4.2	3-25	709	Replace "...; this is discussed in Chapter 10" with "(see section 10.3.2)"
2671	368	JM	Technical	Clarification	3	3.4.2	3-25	710	The relevance of section 3.3.3 is not obvious and perhaps this cross-reference should be dropped.
2672	369	JM	Technical	Clarification	3	3.4.3	3-26	743	Insert phrase in middle of sentence: "...dissolve, break, or tear during sample collection or processing, thus invalidating the sample."
2673	370	SB	technical	commentary	3	3.4.3	3-26	747-750	Pore size is not the only determinant of filter collection properties. Collection of very small particles occurs mostly by diffusion and particle sizes much smaller than the pore size will be collected with high efficiency on filters.
2674	371	JM	Editorial	Style	3	3.4.3	3-26	953	Replace "where" with "if"
2675	372	JM	Technical	Suggestion	3	3.5	3-27	769-771	The concept expressed in this sentence should be included in the list of recommendations at the end of the chapter, e.g. "MARLAP recommends that the level of specificity in the APSs be limited to those requirements that are considered essential to meeting the project's analytical data needs."

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2676	373	JM	Editorial	Grammar	3	3.6	3-27	792	Replace "if it exists" with "if they exist"
2677	374	JM	Editorial	Typo	3	3.5	3-28	803-804	Correct section references to "3.3.7" (in 4 places on these two lines)
2678	375	JM	Editorial	Typo	3	3.5	3-28	807-810	Correct the four entries under "Evaluation criteria" to refer to "Section 8.5.2"
2679	376	JM	Editorial	Typo	3	3.5	3-28	807-810	Correct the four entries under "Frequency" to refer to "Section 3.3.10"
2680	377	JM	Technical	Suggestion	3	3.5	3-28	807-810	Replace the four entries under "Type" with the following: "Method blank (Section 3.3.10), Duplicate (Section 3.3.10), Matrix spike (Section 3.3.10), and Laboratory control sample (Section 3.3.10)"
2681	378	JM	Editorial	Suggestion	3	3.5	3-28	813-821	Check all the cross-references under the column labelled "Special Requirements"
2682	379	SB	technical	clarification	3	3.5	3-29	831	Figure 3.3: Should the lab know what the action level is? Might they analyze or report differently depending on the value, instead of just following an approved procedure? Whatever the answer, it could be discussed nearby this Figure.
2683	380	JM	Editorial	Grammar	3	3.5	3-29	828	Insert comma after "analyte" in Row 2 of "Analysis Limitations"
2684	381	JM	Technical	Style	3	3.7	3-30	864	Add to end of this line "and matrix combination"
2685	382	JM	Technical	Suggestion	3	3.7	3-30	869-870	Reword this recommendation as follows: "MARLAP suggests that the MQO for the detection capability for a given analyte/matrix combination be expressed as a minimum detectable concentration (MDCs) if the lower bound of the gray region is zero and decisions are to be made about individual items or samples."
2686	383	JM	Technical	Suggestion	3	3.7	3-30	871-872	Reword this recommendation as follows: "MARLAP suggests that the MQO for the detection capability for a given analyte/matrix combination be expressed as a minimum quantifiable concentration (MQC) if the lower bound of the gray region is at or near zero and decisions are to be made about a sample population."
2687	384	JM	Editorial	Typo	3	3.8	3-31	887	Couldn't get to the web site using this address. Replace "/filesfin.htm" with "/obtain.htm"
2688	385	BB	editorial	format	3	3.3	All	122 ff	The clear inclusion of an "Output" statement at the end of the discussion of each Analytical Planning Issue is very helpful in understanding the value (importance) of each item discussed (pp 3-2 to 3-22)
2689	386	BB	editorial	suggestion	3	3.4	3-23	Table 3.1	The text seems to be quite repetitive of the information given in Table 3.1 without giving any added value. The authors or technical editor should consider deleting one or the other.
2690	387	JM	Editorial	Style	4	4.1	4-1	6	Insert (APSS) after "Analytical Protocol Specifications"
2691	388	BB	editorial	Organization	4	4.5.3, 4.6.1	4-11	306 ff	Table 4.2 seems to be in an awkward place in the text. In its current location, it is referred to in Section 4.5.3., which contains text relating to small projects. One must page over quite a bit to find the other, primary reference to this table in Section 4.6.1. Could the text before the table be revised to indicate that this table applies in some way to both small and large projects?
2692	389	BB	editorial	suggestion	4	4.5.1	4-7	193 ff	Table 4.1 needs a better caption to describe the purpose of the table more clearly. Perhaps it could read something like "Comparison of contents in different plan documents."
2693	390	SB	editorial	typo	5	5.3.5	5-4	136	Think you mean Appendix C
2694	391	SB	technical	suggestion	5	5.3.5	5-4	134 ff	I wondered when QC samples should be blind to the analyst. Chapter 18 and Appendix C do discuss this issue to some extent, but maybe a specific cross-reference is needed here.
2695	392	JL	technical	commentary	5	5	All		On a practical problem, there is no guidance for "what do you do if no one bids on your project?" For small projects, it might not be very lucrative, so labs might not bid. What do you do?
2696	393	BB	technical	commentary	5	5.4.3.3	5-11	376-378	Timely reviews of the data packages is a very important point. This cannot be emphasized enough. Without feedback from this review process, the whole process could suffer because needed changes would not be identified in a timely or effective manner.

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	Row	Source	Category	Classification	Chap	Section	Page	Line	Comment
2697	394	BB	Technical	commentary	5	5.3.3	5-3	110-111	The suggested statement “A method uncertainty of 0.5 Bq/g is required at the action level of 5.0 Bq/g” seems curious as written. Shouldn’t the emphasis be on keeping the uncertainty to less than or equal to 0.5 Bq/g? As written, it sounds like the uncertainty is required to equal a particular value.
2698	395	SB	editorial	typo	6	6.1	6-1	30	"panning" should be "planning". Or perhaps you are talking film criticism.
2699	396	SB	Technical	clarification	6	6.4	6-11	159	How would one define the value of the "screening level"? I can't remember whether this issue is covered elsewhere.
2700	397	SB	editorial	terminology	6	6.4	6-11	185	"Robustness" is used here, whereas "ruggedness" seems to be preferred elsewhere. If there is a difference, it should be explained. Also p. 6-14, line 257
2701	398	SB	technical	commentary	6	6.5.1	6-13	236 ff	This section seems to be addressed to the laboratory rather than to the project planners, which is unique. Probably not a key problem, but disconcerting to me.
2702	399	SB	technical	clarification	6	6.6.2	6-28	727 ff	Table 6.1: The basis for the numbers (e.g., "Three to five groups of two samples with concentrations within 20% of each other" or 3 concentrations levels with 7 replicates) was not clear to me. They are probably reasonable, but I'd like to know how they were established.
2703	400	BB	editorial	suggestion	7	7.1	7-1	25	The phrase "...final evaluation of the protocol's performance..." should be re-written. The protocol doesn't do anything. The laboratory uses the protocol in its performance.
2704	401		technical	suggestion	7	7.2.2.3	7-8	226	For biological samples, cooling or freezing may be a better method of preservation than adding biological preservatives, which is suggested here.
2705	402	SB	technical	clarification	7	7.4.1.1	7-24	704	Equation 7.3 is supposed to hold at the UBGR. Is this true even if the action level is not at the UBGR?
2706	403	SB	technical	commentary	8	8.2.2.3	8-4	124 ff	also raised the same question in my mind (cf comment for pg 5-4, line 134 ff, about when samples should be blind to the analyst)
2707	404	SB	editorial	typo	8	8.2.3	8-5	140	No comma needed after "Although".
2708	405	SB	technical	clarification	8	8.2.3	8-5	136-137	Regarding combination of the verification and validation steps, it is stated here that " <i>...they may be combined - with the verification activities constituting the bulk of the review.</i> " It is not clear why this should be the case; as described in section 8.5, validation does not appear to require significantly less effort than verification.
2709	406	SB	technical	suggestion	8	8.2.3	8-6		Suggest that the data quality assessment portion of this flow chart (Figure 8.1) indicate that the verification and validation reports be reviewed as a part of data quality assessment phase.
2710	407		Technical	clarification	8	8.3	8-7	192 ff	This section is devoted to the validation plan. It invites the question as to whether or not there should be a verification plan and a section devoted to it.
2711	408		editorial	format	8	8.5	8-13	341 ff	I found the format used here, that spelled out verification and validation points very clearly, made the concepts easy to follow and understand.
2712	409	SB	editorial	suggestion	8	8.5	8-14	380	Excess verbiage. Suggest deleting "reliably identify analytes".
2713	410	SB	technical	suggestion	9	9.2	9-2	32 ff	How one selects the data verifiers, validators, and assessors should be discussed here. Can some of them come from the performing laboratory? From the sponsoring organization (e.g., EPA, DOE, NRC, or the Armed Forces)? From the financially responsible parties? From an outside organization contracted to do it? What qualifications are essential?
2714	411	SB	editorial	typo	9	9.2	9-3	71	"rational" should be "rationale".
2715	412	SB	editorial	suggestion	9	9.6.4.1	9-24	645-651	Should call to Figure 18.1 as an example
2716	413	TG	Editorial	Grammar	10	10.1.1	10-2	41	add comma ...to ensure that modifications, discrepancies and...

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	Row	Source	Category	Classification	Chap	Section	Page	Line	Comment
2717	414	TG	editorial	suggestion	10	10.1.2	10-3	71	Suggest: " <i>Sample packaging, radiological surveys, shipping, and tracking; and...</i> "
2718	415	TG	editorial	Organization	10	10.2.3.1	10-4	115-123	This section on containers should cross-reference section 10.3.3.1, which although titled " <i>Sample Acidification</i> " also discusses relationships among sample containers, analytes and preservation , e.g., lines 699 to 719 in chapter 10.
2719	416	TG	technical	commentary	10	10.2.4	10-6	173-176	" <i>The project manager needs to determine if a sample number scheme may introduce bias into the analysis process. That is, the lab may be aware of trends or locations from the sample identification and this could influence their judgment as to the anticipated result and thereby introduce actions on the part of lab personnel that they would not otherwise take.</i> " [This recommendation is short-sighted and implies that labs are not trustworthy. In particular, labs need to be aware of "hot" samples because they may use separate areas and or labware for processing. In fact in section 12.2.2, lines 146-148, it is suggested that knowledge of historical or field screening data is useful to labs in preventing cross-contamination. In section 12.2.4, lines 313-314 it is stated that: " <i>Operations should be segregated according to activity level. Separate equipment and facilities should be used for elevated and low-level samples whenever possible.</i> "]
2720	417	TG	technical	commentary	10	10.2.5	10-8	217-219	The time to date of analysis is usually captured in pre-established holding times, not left to the judgement of field sampling personnel who make the log or data form entries.
2721	418	TG	technical	commentary	10	10.2.7	10-9		We have found it useful to include a section on the chain of custody document indicating a radiation survey of the package, especially when no shipping manifest will be used (e.g., samples hand delivered to lab).
2722	419	TG	technical	suggestion	10	10.2.11	10-13	369	Suggest adding the following sentence: " <i>In almost every case, field sampling personnel will be subject to State or Federal occupational safety regulations. A few of the hazards peculiar to field sampling are discussed in the following sections, but these should not be considered to be the basis of a comprehensive occupational health and safety program.</i> "
2723	420	TG	Editorial	Style	10	10.2.11.1	10-13	378	add text: At a minimum, drilling rig workers should...
2724	421	TG	technical	commentary	10	10.2.11.1	10-13	382	Special safety precautions may also required when field personnel have to enter trenches to take samples.
2725	422	JJ	technical	suggestion	10	10.2.11.1	10-14	408	A paragraph on the hazards of uv radiation should be added along with the heat stress.
2726	423	TG	Editorial	Reference	10	10.2.11.2	10-15	461	Citation to "Department of Energy (1994)" should include a, b, c, or, d as there are four DOE (1984) references in the reference section.
2727	424	JJ	technical	commentary	10	10.2.11.2	10-16	469	Film badges and TLDs are not the only personnel dosimeters available. The Luxel dosimeter from Landauer appears to be a good alternative.
2728	425	TG	Editorial	Typo	10	10.3.2	10-19	581	correct text: "involve s" should be "involves"
2729	426	SB	editorial	terminology	10	10.3.2.1	10-19	611	Last word should be "turbidity".
2730	427	TG	technical	clarification	10	30.3.2.1	10-20	631	higher than what?
2731	428	TG	Editorial	Style	10	10.3.2.2	10-21	653	modify text: Should read: ...advantage of filtering in the field is that acid...
2732	429	TG	technical	commentary	10	10.3.2.2	10-21	660-661	"... <i>radionuclides that are highly insoluble, such as isotopes of uranium, thorium, and plutonium...</i> " This is an invalid premise. Uranium is somewhat soluble and occurs dissolved in some groundwaters. Thorium and plutonium are better described as relatively immobile in the environment rather than insoluble, because thorium nitrate, for example, is certainly soluble.

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2733	430	TG	technical	suggestion	10	10.3.3.1	10-22		Somewhere in this section, or referenced from this section, it would be useful to have a table in which the known problems related to container and type of acid for the various radionuclides, matrices, and analytical methods are addressed. USGS documents usually indicate HCl rather nitric acid as a preservative for water. Is there a good reason for this? Another possibility would be to address these sampling concerns in section 14.10.9.
2734	431	TG	Editorial	Style	10	10.3.3.1	10-23	725	modify text: loss of radionuclide from the sample.
2735	432	TG	technical	commentary	10	10.3.3.2	10-24	766	The statement "...paper pulp has been shown to remove more than 95 percent of radionuclides from solution..." seems too general. Tritium, for example, would not likely be removed by paper pulp.
2736	433	TG	Technical	Clarification	10	10.3.4.1	10-26	825-826	What is a "...universal adapter and fill-line..."
2737	434	TG	technical	commentary	10	10.3.5	10-27	839	The following sentence is much too simplistic as guidance for selecting milk sampling sites: " <i>Raw milk should be obtained from the closest cows or goats downwind from a source.</i> " For example, background sites should also be selected, and processed milk may have to be collected to fully characterize the impact on the general public. Significant iodine releases are much more likely to result from accidental exposures, which may be short term, than from continuous routine releases. Relying on a single "downwind" sampling location could potentially result in underestimating the impact of an episodic event.
2738	435	TG	technical	suggestion	10	10.3.4.1	10-27	841	Although mentioned in Table 10.1, adding formaldehyde to milk samples may require the samples, once analyzed, to be disposed of as chemical hazardous waste. This should be emphasized in the text as well as being mentioned in the table.
2739	436	TG	technical	suggestion	10	10.3.4.1	10-27	844-847	The recommendation to add NaI to milk samples should be limited to those samples destined for analyses involving radiochemical separation of iodine. Most milk samples for iodine analyses are analyzed by simple gamma-ray spectroscopy of the milk.
2740	437	TG	editorial	typo	10	10.3.5	10-28	895	Typo: 201/202Th should probably be 230/234Th
2741	438	SB	editorial	typo	10	10.4	10-29	918	Should be "appropriate" without a "d".
2742	439		technical	suggestion	10	10.4	10-29		Sampling a soil profiles and sediment cores for measuring total inventory is an important technique and is not present. Remove soil at certain depths and do an integrated curve. And plot activity vs. depth (c.f., EML manual).
2743	440	SB	technical	suggestion	10	10.4.1.1	10-30	950	Removing vegetative matter: lab needs to document weight and amount removed from a sample so that environmental concentrations can be estimated appropriately for the exposure scenario(s) of interest.
2744	441	SB	technical	suggestion	10	10.4.1.1	10-30	950 ff	This section talks about the possible need to remove vegetative matter, rocks, and debris from soil samples before analysis. It could be clearer that the lab needs to document the weight and nature of the material removed, because the average concentration in that fraction could well be different, often lower, than in the fraction analyzed. Whether the measured concentration needs to be adjusted before comparison with an action level depends on the exposure scenario that led to the action level. For example, if exposure via soil ingestion is the dominant route, then the concentration in the fine fraction is appropriate and no adjustment is needed. If exposure via external gamma is dominant, then the DCGL would have been calculated assuming uniform distribution in soil, and use of the measured concentration in the fines would overestimate the risk; an adjustment is needed. This point is discussed a bit on page 15-71, but not enough, in my view. The same question arose when I read p. 3-24, line 691 ff.
2745	442	TG	technical	suggestion	10	10.4.2.1	10-31	1001-ff	This section implies total reliance on models for description of initial mixing and transport dispersion of radionuclides discharged to water. The use of dye or other tracer studies for complex situations should be acknowledged.

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	Row	Source	Category	Classification	Chap	Section	Page	Line	Comment
2746	443	TG	technical	suggestion	10	10.4.3.2	10-33	1066-1068	Use of inedible plants and non-game species as indicator organisms should be mentioned here.
2747	444	TG	technical	commentary	10	10.4.3.2	10-33	1073-1075	This guidance is not very useful. Most agricultural fields and gardens are fertilized, and, except for TENORM situations or gross measurements, laboratories have no difficulty distinguishing the radionuclides of concern from natural radionuclides.
2748	445	TG	technical	suggestion	10	10.4.3.2	10-33		In selecting foods and locations for food sampling, there is often the temptation to limit consideration of consumption habits to those of European-descended populations. The consumption and lifestyle habits of native peoples and other ethnic minorities can be quite different and should also be considered. It might be worthwhile to recommend this in MARLAP.
2749	446	TG	technical	commentary	10	10.4.3.2	10-34	1110-1113	Again, laboratories will have no difficulty distinguishing anthropogenic radionuclides from 40K or 7Be.
2750	447	TG	technical	clarification	10	10.4.3.2	10-35	1127-1128	Except perhaps for aesthetic reasons, why must stomach or rumen contents be collected within a brief period (two to four hours) after death?
2751	448	TG	technical	suggestion	10	10.5.1	10-38	1221	In my experience, "reliable calibrated air flow measuring device" on air sampling stations is an oxymoron. An alternative which may be a little less accurate, but far more reliable, is to simply measure the flow after placing a new filter on the device and then just before it is removed, and averaging the results. This average flow rate is multiplied by the run time (sampler should be equipped with a simple run-time meter) to get the total flow through the filter. The same flow rate meter, which is taken from station to station and checked frequently for calibration, provides good station to station precision in airflow.
2752	449	TG	technical	suggestion	10	10.5.3	10-39	1286	"...222Ra and 220Ra..." should be "...decay products of 222Rn and 220Rn..." Also radon decay products will always interfere with evaluation of both alpha and beta emitting radionuclides by gross particle counting unless time is allowed for them to decay or unless there are very large quantities of anthropogenic radionuclides on the filter.
2753	450	JJ	technical	commentary	10	10.5.3	10-39	1287	A holdup time of several days, not just several hours, is required if Rn-220 decay products are of concern since Pb-212 has a half-life of 10.6 hours.
2754	451	TG	technical	Clarification	10	10.5.2	10-39	1261-1278	Should Teflon (polytetrafluoroethylene, PTFE) fiber filters be cautioned against due to their high ashing temperatures and difficulty with digestion?
2755	452	TG	technical	Commentary	10	10.5.3	10-39	1282-1283	Folding filters for storage makes it difficult to do gross alpha and beta measurements with a proportional counter.
2756	453	GB	editorial	suggestion	10	10.5.4.1	10-40	1327	Given in traditional units (microCi/mL); should be in SI.
2757	454	TG	technical	commentary	10	10.5.4.2	10-41		Noble gases in air have also been collected for laboratory analysis by compressing air into SCUBA tanks, by collecting in impermeable plastic bladders (e.g., Tedlar) for later compression, or by cryogenic methods. Radon is not an issue if laboratory analysis is delayed sufficiently for decay.
2758	455	TG	technical	commentary	10	10.5.4.3	10-41		Electrets can also be used for tritium monitoring at sufficiently high levels. Electrets were discussed for radon so a mention in the tritium section may also be appropriate. (e.g., RA Surette et al "Evaluation of electret ion chambers for tritium measurements," Health Physics 65:418-421(1993)
2759	456	TG	technical	commentary	10	10.5.4.3	10-42	1377	Although mentioned earlier, molecular sieve is not identified here for collecting tritium. It is being used increasingly because of favorable properties such as less retained water following bakeout and better collection properties in environments of fluctuating temperatures.

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	Row	Source	Category	Classification	Chap	Section	Page	Line	Comment
2760	457	JJ	technical	suggestion	10	10.5.5	10-42	1382	The radon section should include a description of the methods for analysis of Rn-220 decay products and a paragraph on radon flux measurements.
2761	458	TG	technical	commentary	10	10.5.5.2	10-46		While not necessarily a bad thing, there is a disproportionate amount of space devoted to radon. It is all good information, but invites the question why are there not other sections like "Selecting H-3 sampling methods Based on Data Quality Objectives" (DQOs) or for any other radionuclide as well?
2762	459	TG	technical	suggestion	10	10.6.2	10-50	1656-1658	It would be very useful to indicate or reference suitable combinations of liquid scintillation fluids (cocktails) and filters for the liquid scintillation method of wipe testing.
2763	460	TG	technical	reference	10	10.7	10-53	1747	It should be noted that the reference: Department of Energy (DOE), EML Procedures Manual (HASL-300), Environmental Measurements Laboratory, is available on CD and on the internet < http://www.eml.doe.gov/publications/procman.cfm >. It is no longer distributed in paper copy. This reference should be checked in other chapters as well.
2764	461	GR	editorial	format	10	10	10		Some Chapters have references cited vs bibliography. Make reference as complete as possible.
2765	462	TG	Editorial	Style	11	11.1	11-1	5	Suggest: "...topics are presented sequentially in this chapter..."
2766	463	TG	Editorial	Style	11	11.1	11-1	26	Suggest: "Other relevant issues, including the laboratory's radioactive materials license conditions..."
2767	464	G2	editorial	typo	11	11.1	11-1	27	Missing part of word at end of line. Should this be "tracking activities"?
2768	465	TG	technical	clarification	11	11.1	11-1	30	This statement in association with the references, which are limited to radiological guidance, suggests that radiological safety is the only kind of safety that needs to be considered.
2769	466	TG	Editorial	Reference	11	11.1	11-1	30	NRC 1998a is not listed in the references for this section.
2770	467	TG	Editorial	Style	11	11.2.1	11-3	33	Suggest: "...should know the approximate numbers..."
2771	468	G1	technical	clarification	11	11.2.3	11-4	73-75	Page 11-4 (lines 73-75) states that laboratory facilities that handle radioactive materials are required to have a radioactive materials license issued by the NRC or the Agreement State in which the laboratory operates, with the exception of certain DOE national laboratories and DOD laboratories. However, it is important to make clear that the latter facilities themselves cannot handle unrestricted levels of radioactive materials. They operate under similar types of regulation-driven restrictions as other laboratories, that are administered internally.
2772	469	G1	technical	commentary	11	11.3.1	11-6	137	Page 11-6 seems to mandate a designated receiving location for all samples, and page 11-14 states that sample storage areas must be posted as radiation areas. For small projects or those limited to the analysis of very low levels of radioactivity, these apparent "mandates" may not be applicable or may even be counter-productive (e.g., by storing low-level samples together with high-level samples).
2773	470	G1	technical	commentary	11	11.3.2	11-8	207	Guidance on line 207 of page 11-8 is to treat contaminated packing material and packages as radioactive waste; not mentioned is the possibility that there may be non-radioactive hazardous contaminants that would require the contaminated material to be classified as mixed waste.
2774	471	TG	Editorial	Style	11	11.3.2	11-8	183-186	This sentence, "An external exposure... ..working hours)." is redundant with a nearly identical sentence in the previous paragraph, lines 176-178.
2775	472	TG	technical	clarification	11	11.5.2	11-13	356-357	On these lines it is stated: " <i>This documentation should be compared to separate paperwork obtained before sample receipt.</i> " What is this separate paperwork and who provides it?

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	Row	Source	Category	Classification	Chap	Section	Page	Line	Comment
2776	473	G1	technical	commentary	11	11.5.3	11-14	376	Page 11-6 seems to mandate a designated receiving location for all samples, and page 11-14 states that sample storage areas must be posted as radiation areas. For small projects or those limited to the analysis of very low levels of radioactivity, these apparent "mandates" may not be applicable or may even be counter-productive (e.g., by storing low-level samples together with high-level samples).
2777	474	TG	technical	suggestion	11	11	all		The relationships among various recommended documentation (" <i>Bench sheets</i> ," " <i>laboratory logbook</i> ," " <i>separate paperwork obtained before sample receipt</i> ," and " <i>documents listing requests for specific analyses</i> ") need to be made clear. Model documents would seem to be useful.
2778	475	G2	technical	suggestion	11	11	11		Address security issue? Might be important here as samples are open because of security and not put back in place. Samples by mail should not be irradiated.
2779	476	TG	technical	commentary	12	12.2.2.1	12-6	152ff	Tritium may also be a problem for cross-contamination if low level measurements are made in an environment where higher-level tritium sources are analyzed or in use.
2780	477	TG	editorial	suggestion	12	12.2.2.1	12-7	166-167	Suggest changing to read: " <i>The laboratory may have background levels of radon progeny from natural sources in soil or possibly in its construction materials.</i> "
2781	478	TG	technical	commentary	12	12	12	General	Overall this chapter is also straightforward and useful.
2782	479	SB	editorial	typo	12	12.3	12-13	lowest diamond	Figure 12.2: To be consistent, "aliquot" should be "aliquant".
2783	480	SB	technical	typo	12	12.3.1.2	12-17	423	Shouldn't first word be "Adsorbed"?
2784	481	TG	technical	clarification	12	12.3.1.2	12-23	646	It is not clear why ashing at 400 to 500 C is recommended for iodine when losses are reported as low as 450 C (Table 12.3)
2785	482	TG	Editorial	Typo	12	12.3.1.3	12-25	705	Should "off" be "of"?
2786	483	TG	technical	suggestion	12	12.3.1.3	12-25	685-716	This approach to weighing samples is certainly meticulous, but one wonders about its applicability to routine analysis of samples. If it is desired to retain this list, it would be useful to also provide an alternative, more practical, guide for weighing under less demanding circumstances.
2787	484	TG	Editorial	Organization	12	12.3.3.1	12-32	884	This subheading, "12.3.3.1 Biological Samples" is redundant with "12.3.3 Biota Samples"
2788	485	TG	technical	commentary	12	12.3.3.2	12-33	Table 12.4	Table 12.4 recommends "burning" as the method to ash fish, meat and flour samples. Although drying, charring and ashing are discussed at length in the text there is no discussion of burning as a sample preparation step. Also this table is not cited from the text.
2789	486	TG	technical	suggestion	12	12.5	12-34	973-974	Suggest changing to read: "Wipe samples may be digested prior to analysis, but more commonly are simply placed into a liquid scintillation vial with cocktail and counted or directly analyzed with appropriate detectors such as proportional or Geiger counters." As written, this section implies that digestion is commonly used for wipe samples and that liquid scintillation is the only method of counting. This section and section 10.6 should be checked for consistency.
2790	487	JJ	technical	commentary	12	12.8	12-40	1139	Bio-assays: The federal Clinical Lab Improvement Act (CLIA) requires that a lab director be an MD (physician) to be present and mention it to give a warning put in sanction.
2791	488	TG	Editorial	Reference	12	12.9.1	12-46	1285-1286	A more complete and useful reference is: Department of Energy, "RESL Analytical Chemistry Branch Procedures Manual", IDO-12096, U.S. Department of Energy, Idaho Falls, Idaho (1982).

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	Row	Source	Category	Classification	Chap	Section	Page	Line	Comment
2792	489	TG	Editorial	Reference	12	12	11		Citations of references do not follow a standard style. In most cases the simple author, year method is used (e.g., line 76), in others the title is additionally given in the text (e.g., lines 233, 672-673, 1047-1048), or even the nationality and discipline of the author is provided (e.g., line 730). Sometimes a cite such as "HASL-300" is given without author or date (e.g., lines 900, 919, 1147), but is listed under "U.S. Department of Energy..." in the reference section. In this example, there are even two editions of HASL-300 listed in the references (lines 1303 and 1308) so it may be important to know which one is meant.
2793	490	SI	Technical	Clarification	13	13.1	13-1	19	insert "or mineral acids" between "with" and "water"
2794	491	SI	Editorial	Style	13	13.1	13-1	26	insert "such" between "ensure" and "exchange"
2795	492	SI	Editorial	Style	13	13.1	13-1	31	delete the first sentence
2796	493	SI	Technical	Clarification	13	13.1	13-1	28-30	change the order to: (1) wet ashing, acid dissolution; (2) microwave digestion; and (3) fusion methods
2797	494	SI	Technical	Clarification	13	13.1	13-2	37	insert "during sample pretreatment" after "explosions"
2798	495	SI	technical	suggestion	13	13.1	13-2	48	add two more useful references: Sample Pretreatment and Separation by Anderson and Chapman, 1987; Chemical Dissolution of Metal Oxides by Blesa, Morando and Regazzoni, 1993
2799	496	SI	Technical	Clarification	13	13.2	13-2	52	delete ", but usually the tracer is added to the sample"
2800	497	SI	Technical	Clarification	13	13.2.1	13-3	71	change "many" to "some"; change "is" to "could be"
2801	498	SI	Editorial	Style	13	13.2.1	13-3	74	insert "For example", before "the solubility product constant ... "
2802	499	SI	Technical	Terminology	13	13.2.1	13-3	82	change "water" to "aqueous solutions"
2803	500	SI	Technical	Terminology	13	13.2.2	13-3	91	replace "fluxes" to "reagents"
2804	501	SI	Editorial	Style	13	13.2.3	13-4	111	change "isotope" to "isotopic"
2805	502	SI	Technical	Terminology	13	13.2.3	13-4	113	replace "all chemical species present" to "the analyte of interest"
2806	503	SI	Editorial	Grammar	13	13.2.3	13-4	123	delete the period after "acids"
2807	504	SI	editorial	Organization	13	13.4.1	13-14	432 ff	Oxidation reduction potential is in all chemistry books and need not be in this Chapter. Put Table 13.3 in Appendix
2808	505	SI	Editorial	Grammar	13	13.2.3	13-5	126	add a period before "dissolution"
2809	506	SI	Technical	Clarification	13	13.2.3	13-5	133	insert "metal" after "soluble"
2810	507	SI	Editorial	Style	13	13.2.3	13-5	136	delete the second "oxidation"
2811	508	SI	Technical	Clarification	13	13.2.3	13-5	137	insert "fusion" before "fluxes"
2812	509	SI	Editorial	Typo	13	13.2.4	13-5	147	change "cation" to "cations"
2813	510	SI	Technical	Terminology	13	13.2.4	13-5	153	change "radionuclides" to "elements"
2814	511	SI	Technical	Clarification	13	13.2.5	13-6	158	insert "sometimes" before "required"; delete "and detection"
2815	512	SI	Editorial	Clarification	13	13.2.5	13-6	170	change "the method" to "a given separation method"
2816	513	SI	Technical	Clarification	13	13.2.5	13-6	171	change "issues" to "possible interactions"
2817	514	SI	Editorial	Style	13	13.2.5	13-6	172	delete "during each step of the procedure"; redundant
2818	515	SI	Technical	Clarification	13	13.3	13-6	177	replace "small" with "an appropriate"
2819	516	SI	Technical	Style	13	13.2.5	13-6	166-169	delete the sentence that begins with "knowledge of the behavior ...", it does not add anything to the discussion
2820	517	SI	Technical	Clarification	13	13.3	13-6	181-182	replace "wet ashing" with "acid treatment"

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	Row	Source	Category	Classification	Chap	Section	Page	Line	Comment
2821	518	SI	Technical	Clarification	13	13.3	13-7	190	add "to a small" between "ground" and "mesh"
2822	519	SI	Technical	Clarification	13	13.3	13-7	219	replace "fusions" with "During fusion, samples are heated ..."
2823	520	SI	Technical	Clarification	13	13.3	13-7	188-189	delete "charring to remove organic material is not usually necessary because" and start the sentence on line 189 with "Samples with significant"
2824	521	SI	Technical	Clarification	13	13.3	13-8	238	add "remove and" between "to" and "dissolve"
2825	522	SI	Technical	Clarification	13	13.3	13-8	251	replace "any" with "most"
2826	523	SI	technical	clarification	13	13.3	13-9	258	Make sure that the statement about cleaning Pt crucibles in boiling HCl is correct. I think HCl can attack Pt?
2827	524	SI	Editorial	Clarification	13	13.3	13-9	261	replace "for fusions" with "in fusions"
2828	525	SI	editorial	clarification	13	13.3	13-9	277	What is meant by "etc."?
2829	526	SI	technical	clarification	13	13.3	13-9	279	explain what is meant by "pyrosulfate fusions or reversible"
2830	527	SI	Editorial	Clarification	13	13.3.1	13-11	332	replace "is" with "could be"
2831	528	SI	Editorial	Style	13	13.3.2	13-12	352	delete "rather"
2832	529	SI	Technical	Clarification	13	13.3.3	13-13	391	replace "chromatography" with "extraction"
2833	530	SI	technical	commentary	13	13.3.3	13-13	392-394	other elements such as Pb and Po can also be volatilized during pyrosulfate fusion
2834	531	SI	technical	clarification	13	13.4.1	13-14	425 ff	Table 13.2: Can HCl alone dissolve cement?
2835	532	SI	Technical	Suggestion	13	13.4.1	13-14	Table 13.3	Has the information been checked against the original reference for typing errors?
2836	533	SI	Technical	Clarification	13	13.4.1	13-17	554	insert "for use in sample treatment with HF" after "preferred"
2837	534	SI	Editorial	Style	13	13.4.1	13-17	546-553	repeated above; see lines 538-545 (delete)
2838	535	SI	Technical	Clarification	13	13.4.1	13-18	556	replace "boils at" with "is"; explain "HF works most efficiently when used alone"
2839	536	SI	Technical	Clarification	13	13.4.1	13-18	561	replace "chemical reactions" with "separation methods"
2840	537	SI	Technical	Clarification	13	13.4.1	13-18	564	replace "wet ashing samples" with "sample dissolution"
2841	538	SI	technical	clarification	13	13.4.1	13-18	572	Can HCl dissolve cement?; insert "completely" for "not"
2842	539	SI	Editorial	Format	13	13.4.1	13-18 & -19	582-591	The direct quote by "Sulcek and Povondra" is non-conforming with the text style
2843	540	SI	Technical	Clarification	13	13.4.1	13-19	595	delete "wet ashing" and insert "dissolution" after "samples"
2844	541	SI	Technical	Clarification	13	13.4.1	13-19	621	insert "concentrated" before "H2SO4"
2845	542	SI	Technical	Clarification	13	13.4.1	13-20	623	insert "separation" before "procedures"
2846	543	SI	Editorial	Style	13	13.4.1	13-20	638	insert "also" after "they"
2847	544	SI	Technical	Clarification	13	13.4.1	13-23	709-710	the sentence starting with "K2Cr2O7 is commonly mixed ...", is incomplete.
2848	545	SI	Editorial	Style	13	13.5.2	13-25	804	delete "However, " and start the sentence with "Waste is minimized ..."
2849	546	SI	Technical	Style	13	13.6.1	13-26 & -27	831-853	this section is too general and incomplete. It is of questionable value to the reader.
2850	547	SI	editorial	suggestion	13	13.6	13-26	General	This section is not well-written and will require extensive editing. It is either too general or very specific with direct quotes from published papers. Some information is either incomplete or not useful. Also, the style is not consistent. This part should be deleted or presented differently. One way is to refer the reader to a specific publication(s) for each special matrix. This is a specific topic

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Row	Source	Category	Classification	Chap	Section	Page	Line	Comment
2851	548	JJ	technical	suggestion	13	13.6	13-26	that requires specific information. The document should include a section on determining solubility of particulate matter in body fluids. The solubility or clearance rate from the lung is a critical factor in dose estimates.
2852	549	SI	Editorial	Style	13	13.6.3	13-27	864 replace "see" with "observe"
2853	550	SI	Technical	Style	13	13.6.4	13-28	870-884 this information is not very useful
2854	551	SI	technical	suggestion	13	13.6.5	13-28	885-909 this information is incomplete and the reader would be much better served if only referred to the complete reports by Gibbs et al., 1978 and Peng, 1977.
2855	552	SI	Technical	Terminology	13	13.5.2	13-29	810 replace "water" with "aqueous samples"
2856	553	SI	editorial	suggestion	13	13.7	13-29	General This section is not well-written and will require extensive editing. It is either too general or very specific with direct quotes from published papers. Some information is either incomplete or not useful. Also, the style is not consistent. This part should be deleted or presented differently. One way is to refer the reader to a specific publication(s) for each special matrix. This is a specific topic that requires specific information.
2857	554	SI	technical	clarification	13	13.7.1	13-30	930-931 Why HF and aqua regia are not included? Who provided this definition? The above combination of acids can provide a very powerful acid leaching method for Pu from large size soil samples (up to 100 g) See Ibrahim et al., 1994; J. of Radioanalytical and Nuclear Chemistry, Vol. 177, No. 1, 127-138.
2858	555	SI	Technical	Clarification	13	13.7.2	13-31	994 The sentence starting with "The analyst must consider ..." is incomplete
2859	556	SI	Editorial	Terminology	13	13.8	13-32	1015 explain "red or white fuming nitric acid"
2860	557	SI	Editorial	Style	13	13.9.1	13-36	1114 replace "or" with "from"
2861	558	SI	Technical	Clarification	14	14.1	14-1	3 What is meant by: The methods of ..., "Collection"?
2862	559	SI	Technical	Commentary	14	14.1	14-1	3 detection of radionuclides are not similar to ordinary chemicals
2863	560	SI	Editorial	Style	14	14.1	14-1	8 delete "in one reference document"
2864	561	SI	Editorial	Style	14	14.1	14-1	13 replace "employed" with "provided"
2865	562	SI	Technical	Reference	14	14.1	14-1	14 What is meant by "agency procedural manuals", can you give examples?
2866	563	SI	Editorial	Style	14	14.1	14-1	16 change "afford" to "give" or "provide"
2867	564	SI	Editorial	Style	14	14.1	14-1	20 replace "found" to employed
2868	565	SI	Editorial	Style	14	14.1	14-1	30 delete "for the practicing radiochemist"
2869	566	SI	Technical	Clarification	14	14.1	14-1	32 delete "because the radiochemist detects atoms by their radiation" and start the sentence with "The success or ..."
2870	567	SB	editorial	typo	14	14.1	14-2	35 "their" should be "its".
2871	568	SI	Editorial	Style	14	14.1	14-2	37 change "behavior" to "nature"
2872	569	SI	Technical	Clarification	14	14.1	14-2	44 move "(radiolysis)" to line 45 after "heat effects"
2873	570	SI	Editorial	Style	14	14.1	14-2	48 delete "modern" and insert "also" after "should"
2874	571	SI	technical	suggestion	14	14.1	14-2	53 A proposed table summarizing the characteristics of alpha, beta and gamma radiation can be inserted (see Table 2 in main body of Panel review report) to illustrate that the extent of radiochemical separation is impacted, in part, by the type of radionuclide emission. This table relates directly to the understanding of the required chemical separation for each type of emission.
2875	572	SI	technical	clarification	14	14.2.1	14-2	57 How is "detection of analyte, tracers, and carriers" related to "oxidation-reduction"? I don't think they are related.

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	Row	Source	Category	Classification	Chap	Section	Page	Line	Comment
2876	573	SI	Technical	Clarification	14	14.2.1	14-2	62	change "number" to "state"
2877	574	SI	Technical	Commentary	14	14.1	14-2	35-37	It gives the impression that coprecipitation is very specific and will yield "pure radionuclide, free of interfering ions". Coprecipitation is very seldom that specific. Re-word the sentence to reflect reality.
2878	575	SI	Technical	Clarification	14	14.2.1	14-2 & -3	68-70	The statement "The differences ..." is not clear; give an example.
2879	576	SB	technical	typo	14	14.2.2	14-4	103	Shouldn't this read U<Cl<F ?
2880	577	SI	Editorial	Style	14	14.2.3	14-6	183-187	Redundant, see priority rules on p. 14-5.
2881	578	SI	Editorial	Style	14	14.2.3	14-7	205	replace "be obtained" by "occur"
2882	579	SI	Editorial	Style	14	14.2.3	14-7	214	define "M" as the "metal ion"
2883	580	SI	Editorial	Style	14	14.2.3	14-7	218	combine both sentences
2884	581	SI	Technical	Clarification	14	14.2.3	14-9	256	before "radiolysis products ..." add "At high levels, radiolysis products ..."
2885	582	SI	Technical	Clarification	14	14.2.3	14-9	265	under "notes" in Table 14.1, indicate that the color of the various chemical forms are visible only in the presence of significant amounts (mass)
2886	583	SB	technical	suggestion	14	14.3.2	14-21	539 ff	Might be useful to provide diagrams of complexed and chelated metals--how the metal ion fits into the agent.
2887	584	SB	technical	clarification	14	14.8.2	14-63	1676	Table 14.1: Shouldn't radium be included in the list of exceptions for sulfates?
2888	585	SB	technical	commentary	14	14.8.3.1	14-68	1819	Just a quibble about solubility being dependent on particle size. I think of solubility being an inherent property of the solute in the limit of infinite time. Size affects mostly the rate of solution. While I understand the fact that molecules can redistribute from small to large particles at concentrations near saturation, I'm not sure that should be called a difference in solubility.
2889	586	SB	editorial	typo	14	14.8.7	14-90	2450	second column: "Sarge" should be "Large".
2890	587	BK	editorial	Organization	14	14.10.	14-107	2955 ff	Organization and headings: Call section 14.10 "Analysis of Specific Radionuclides", which is its subject, rather than "Chemical Equilibrium", which does not describe its contents. Then, place current sections 14.10.1 to 14.10.8 as subheadings in a new section 14.10.1 called "Introduction" or "Overview". Thus, current sections 14.10.9.1 - 14.10.9.12 become 14.10.2 - 14.10.13. To new section 14.10.1, add a brief explanation concerning the selection of the specific radionuclides that follow. The selection makes sense, but should be justified.
2891	588	BK	editorial	suggestion	14	14.10.	14-107	2955 ff	The detailed descriptions of certain aspects of chemical behavior in current sections 14.10.1 - 14.10.8 should be referred to in the specific radionuclide sections to avoid considerable repetition concerning matters such as hydrolysis and polymerization.
2892	589	BK	Technical	Typo	14	14.10.1	14-108	2975	Should be "cesium isotope"
2893	590	BK	technical	commentary	14	14.10.1	14-108	2978	It should be realized that carrier added to a solid may not be uniformly interchanged with the radionuclide
2894	591	BK	technical	clarification	14	14.10.1	14-109	3008	Were these salts mixed as solids or in solution and then the chloride was crystallized?
2895	592	BK	Editorial	Style	14	14.10.1	14-109	3009	Insert "to attempt " after "employed"
2896	593	BK	Editorial	Style	14	14.10.1	14-109	3020	this paragraph should be shifted down behind line 3045
2897	594	BK	Editorial	Style	14	14.10.5	14-114	3153	Move "many" to the front of this sentence
2898	595	BK	Technical	Suggestion	14	14.10.7	14-116	3209	Add that, for accuracy, S1/S2 should be significantly larger than 1
2899	596	BK	Editorial	Format	14	14.10.8	14-118	3280	Move "Earths" to left border

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2900	597	BK	Editorial	Clarification	14	14.10.8	14-119	3299	Replace question mark with page numbers
2901	598	BK	Editorial	Typo	14	14.10.9.1	14-120	3353	Delete last "a" on line
2902	599	BK	technical	Organization	14	14.10.9	14-120	3347 ff	A section on a specific radionuclide usually is read to select or evaluate an analytical method. The contents will be most useful if each brief description is paired with the reference to the detailed description. The current practice of first describing all methods and then bunching the references at the end is not helpful.
2903	600	BK	editorial	suggestion	14	14.10.9	14-120	3347 ff	For specific radionuclides, extensive paragraphs that describe the occurrence, properties, and preparation of minerals and the metallic state should be deleted. Unless they are pertinent to the purpose at hand, a reader can look for these descriptions where the author obtained them. In a large tome such as this, the authors should limit themselves to pertinent information.
2904	601	BK	editorial	suggestion	14	14.10.9	14-120	3347 ff	The authors should reevaluate use of qualitative judgements of amounts of specific radionuclides, their toxicity, and the difficulty of analysis (examples are discussed elsewhere in this list of comments). The MARLAP document may somewhere have quantitative information or make reference to such information concerning amounts, doses and costs that could be used to place amounts and effects in perspective.
2905	602	SB	editorial	suggestion	14	14.10.9	14-120	3347 ff	I was surprised that Chapter 14 contained the very long sub-subsection (14.10.9) on specific radionuclides. The latter could easily have been a separate chapter or, perhaps better, an appendix. But it may actually be the section of most use to the laboratory faced with a specific type of analysis.
2906	603	BK	Technical	Terminology	14	14.10.9.1	14-121	3361	Replace "military" with "various plutonium"
2907	604	SB	technical	clarification	14	14.10.9.1	14-122	3394	Do rocks actually absorb Am(III), or is it adsorption?
2908	605	BK	editorial	suggestion	14	14.10.9.1	14-125	3502	It would be useful, here and elsewhere, to specify the alpha particle and gamma ray energies used for spectral analysis; if they are listed elsewhere in MARLAP, this list should be referred to for each radionuclide
2909	606	BK	technical	Organization	14	14.10.9.1	14-125	3509	This mixture of references is not useful; the reader will want to be referred to specific papers for the method of interest.
2910	607	BK	technical	commentary	14	14.10.9.2	14-125	3518	Information about the metal is not useful in MARLAP and should be deleted
2911	608	BK	technical	suggestion	14	14.10.9.2	14-126	3527	The only aspects of interest under "Occurrence" concern (1) stable cesium in media submitted for analysis that may affect the analytical results and (2) radioactive cesium in media submitted for analysis; delete all other contents.
2912	609	BK	Editorial	Style	14	14.10.9.2	14-127	3565	Delete "and" after "solutions"
2913	610	BK	Editorial	Typo	14	14.10.9.2	14-128	3587	Delete "a" before "hydrocarbons"
2914	611	BK	Technical	Reference	14	14.10.9.2	14-128	3595	Give reference to the cited experiments
2915	612	BK	Editorial	Typo	14	14.10.9.3	14-130	3663	principal (sp.)

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2916	613	BK	Technical	Style	14	14.10.9.3	14-135	3826	kaolinite, "bentonite", "montmorillonite" (sp.)
2917	614	BK	Technical	Clarification	14	14.10.9.4	14-137	3873	Add I-123, according to line 3913
2918	615	BK	Editorial	Grammar	14	14.10.9.4	14-137	3893	Delete comma after "Chernobyl"
2919	616	BK	Editorial	Style	14	14.10.9.4	14-138	3907	Delete "for" after "analyzed"
2920	617	BK	technical	commentary	14	14.10.9.4	14-140	3963	The discussion of toxicity and radiotoxicity in this paragraph is not appropriate in this context; any warning to analysts should be in specific terms about use and quantity
2921	618	BK	technical	suggestion	14	14.10.9.4	14-140	3988	Check reference whether the last line on this page in Table 14.19 should be moved to this line
2922	619	BK	Technical	Format	14	14.10.9.4	14-141	3995	This information should be added to the box at line 3989
2923	620	BK	Editorial	Typo	14	14.10.9.4	14-141	4002	state after "oxidation" (sp.)
2924	621	BK	Technical	Typo	14	14.10.9.4	14-141	4007	Move "-1" to exponent in second "I"
2925	622	BK	Editorial	Style	14	14.10.9.4	14-143	4056	Insert "on" after "remain"
2926	623	BK	Editorial	Grammar	14	14.10.9.5	14-144	4086	Insert comma after "94"
2927	624	BK	Technical	Suggestion	14	14.10.9.5	14-144	4109	Add that Pu-238 is in the environment from a destroyed satellite power source
2928	625	BK	Editorial	Typo	14	14.10.9.5	14-147	4180	coastal (sp.)
2929	626	BK	technical	clarification	14	14.10.9.5	14-147	4203	Table 14.20: Should second Pu+3 be Pu?
2930	627	BK	Editorial	Typo	14	14.10.9.5	14-151	4303	have, not "has"
2931	628	BK	Editorial	Typo	14	14.10.9.5	14-151	4307	are, not "is"
2932	629	BK	Editorial	Typo	14	14.10.9.5	14-152	4347	carbamyphosphine (sp.)
2933	630	BK	Editorial	Grammar	14	14.10.9.5	14-152	4351	affect, not "effect"
2934	631	BK	Editorial	Typo	14	14.10.9.5	14-153	4374	electrodeposition (sp.)

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2935	632	BK	Editorial	Grammar	14	14.10.9.6	14-154	4431	Insert comma after "part"
2936	633	BK	Technical	commentary	14	14.10.9.6	14-156	4475	Same comment as given for line 3963 applies to "highly toxic" discussion
2937	634	BK	Editorial	Typo	14	14.10.9.6	14-157	4523	Delete "their"
2938	635	BK	Technical	Typo	14	14.10.9.6	14-159	4563	Replace "SO4-2" with "SO3-2"
2939	636	BK	Technical	Typo	14	14.10.9.6	14-159	4569	Replace "BaIO3" with "Ba(IO3)2"
2940	637	BK	Technical	Typo	14	14.10.9.6	14-159	4571	Replace "Th(C2O4)" with "Th(C2O4)2"
2941	638	BK	Editorial	Grammar	14	14.10.9.6	14-159	4595	absorb not "absorbs"
2942	639	BK	technical	suggestion	14	14.10.9.6	14-160	4616	The interference is there, but can be corrected on the basis of secondary U-235 gamma rays
2943	640	BK	editorial	clarification	14	14.10.9.6	14-160	4618	"lengthy and expensive" must be placed in context: relative to what procedure, or what are the cost and time?
2944	641	BK	technical	suggestion	14	14.10.9.6	14-160	4624	Delete "alpha- or"; for reliable gamma counting, the radon gas must be uniformly distributed in the container
2945	642	BK	Editorial	Style	14	14.10.9.6	14-160	4626	Delete "however" and begin a new sentence
2946	643	BK	Technical	Suggestion	14	14.10.9.6	14-161	4631	Insert "beta, or gamma" after "alpha,"
2947	644	BK	Technical	Typo	14	14.10.9.7	14-162	4683	Change "90Sr" to "88Sr"
2948	645	BK	technical	clarification	14	14.10.9.7	14-163	4710	Should "strontium carbonate" be "divalent strontium ions"?
2949	646	BK	technical	suggestion	14	14.10.9.7	14-164	4742	Add "to leach strontium"
2950	647	BK	technical	suggestion	14	14.10.9.7	14-165	4770	Add extraction of strontium with di-2-ethylhexyl phosphoric acid
2951	648	BK	technical	suggestion	14	14.10.9.8	14-168	4868	This section is incomplete, as indicated by more detailed discussions of solubilities in lines 4885, 4893, and 4950 4880 This advice depends on the amount of Tc-99 handled, hence it does not apply to environmental samples; as indicated above, terms like "high specific activity" need to be replaced by quantitative guidance
2952	649	BK	Editorial	Typo	14	14.10.9.7	14-169	4888	principal (sp.)

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2953	650	BK	Editorial	Format	14	14.10.9.8	14-169	4891	This heading is "Solubility of Compounds" for other radionuclides
2954	651	BK	Editorial	Style	14	14.10.9.8	14-171	4960	Delete "to" at end of line
2955	652	BK	technical	clarification	14	14.10.9.8	14-172	5005	How low is "low"?
2956	653	BK	Technical	Terminology	14	14.10.9.8	14-172	5020	Replace "beta" with "conversion electron"
2957	654	BK	Editorial	Typo	14	14.10.9.8	14-173	5025	exchanged instead of "exchange"
2958	655	BK	Editorial	Typo	14	14.10.9.8	14-173	5029	called instead of "call"
2959	656	BK	Technical	Clarification	14	14.10.9.9	14-178	5211	insert "or stainless steel" after "platinum"
2960	657	BK	Editorial	Grammar	14	14.10.9.1 0	14-181	5287	release instead of "releasing"
2961	658	BK	Editorial	Grammar	14	14.10.9.1 0	14-181	5296	are instead of "is"
2962	659	BK	Technical	Clarification	14	14.10.9.1 0	14-181	5305	1.5 instead of "twice"
2963	660	BK	technical	clarification	14	14.10.9.1 0	14-182	5320	Clarify "selectively exchange": do they selectively accumulate or release?
2964	661	BK	technical	suggestion	14	14.10.9.1 0	14-183	5365	Comment is needed here on the existence and extent of organically bound tritium (mentioned in line 5381) in the environment
2965	662	BK	technical	suggestion	14	14.10.9.1 0	14-184	5388	Mention here the process for oxidizing tritium to measure gaseous or organically bound tritium as tritiated water
2966	663	BK	technical	suggestion	14	14.10.9.1 0	14-184	5391	State here that the purpose is to measure tritium as gas in a gas-filled proportional counter
2967	664	BK	technical	suggestion	14	14.10.9.1 0	14-185	5411	Mention here use of azeotropic distillation with an organic solvent such as cyclohexane to extract tritiated water from biota samples
2968	665	BK	technical	suggestion	14	14.10.9.1 1	14-186	5440	Mention here that man-made U-236 can also be found
2969	666	BK	Editorial	Typo	14	14.10.9.1 1	14-192	5638	First word is "from" (sp.)
2970	667	BK	Editorial	Typo	14	14.10.9.1 1	14-194	5700	used instead of "use"
2971	668	BK	Editorial	Typo	14	14.10.9.1 1	14-194	5712	carbamyphosphine (sp.)

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2972	669	BK	Editorial	Grammar	14	14.10.9.1 1	14-195	5739	Add comma after "acid"
2973	670	BK	Editorial	Grammar	14	14.10.9.1 1	14-195	5747	Insert period after "acid"
2974	671	BK	technical	clarification	14	14.10.9.1 1	14-195	5754	more strongly than what or when?
2975	672	BK	Technical	Clarification	14	14.10.9.1 1	14-195	5756	Should "Absorbance" be "Absorption"?
2976	673	BK	Editorial	Grammar	14	14.10.9.1 1	14-196	5764	exists instead of "exist"
2977	674	BK	Technical	Clarification	14	14.10.9.1 1	14-196	5783	Insert "or stainless steel" after "platinum"
2978	675	BK	Technical	Clarification	14	14.10.9.1 2	14-198	5839	Delete gamma symbol at end (less than 0.01% gamma)
2979	676	BK	Editorial	Grammar	14	14.10.9.1 2	14-199	5865	Delete comma after "mercury"
2980	677	BK	Editorial	Grammar	14	14.10.9.1 2	14-199	5884	Delete either "is" or "becomes" after "metal"
2981	678	BK	editorial	suggestion	14	14.10.9.1 2	14-200	5895	Replace "very small quantities" with a description that places such quantities in context (e.g., quantities small compared to ...)
2982	679	BK	Technical	Clarification	14	14.10.9.1 2	14-200	5904	Replace "monovalent" with "tetravalent"
2983	680	BK	editorial	suggestion	14	14.10.9.1 2	14-200	5914	Insert "with analyses for other radionuclides" after "proceeding", if that is the intended meaning
2984	681	BK	technical	clarification	14	14.10.9.1 2	14-201	5928	"high pH (1 - 2 M)" doesn't make sense; are some words missing?
2985	682	BK	Editorial	Grammar	14	14.10.9.1 2	14-203	6006	used instead of "use"
2986	683	BK	Editorial	Typo	14	14.10.9.1 2	14-203	6007	from instead of "form"
2987	684	BK	Editorial	Typo	14	14.10.9.1 2	14-203	6011	tracer instead of "tracers"
2988	685	BK	Editorial	Typo	14	14.10.9.1 2	14-204	6031	from instead of "form"
2989	686	BK	Editorial	Typo	14	14.11	14-205	6068	Health (sp.)
2990	687	BK	Editorial	Typo	14	14.11	14-208	6157	Horwitz (sp.)
2991	688	BK	Technical	Reference	14	14.11	14-209	6166	Are all three references to the same report in different years (lines 6171, 6175) needed?
2992	689	BK	Editorial	Typo	14	14.11	14-214	6300	Nuclear (sp.)

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2993	690	BK	Editorial	Typo	14	14.11	14-216	6365	Delete this duplicate of the reference on line 6363
2994	691	BK	Editorial	Clarification	14	14.11	14-217	6383	Replace "submitted to" with volume and page numbers
2995	692	BK	Editorial	Reference	14	14.11	14-217	6384	This does not appear to be a readily accessible reference and should be replaced if possible. Others in this category are in lines 6388, 6429, and 6458
2996	693	BK	Editorial	Reference	14	14.11	14-218	6427	If this is more or less the same reference as on line 6424, delete it
2997	694	BK	Editorial	Reference	14	14.11	14-220	6461	Reference is incomplete
2998	695	BK	Editorial	Typo	14	14.11	14-221	6497	Nuclei (sp.)
2999	696	BK	Editorial	Reference	14	14.11	14-226	6620	Move "Zolotov" to beginning of line; is this reference needed, since it is the same reference as in lines 6504 and 6526?
3000	697	BK	technical	suggestion	14	14.10.9	14		Remove the various comments on the toxicity or hazard of a radionuclide except when advising on sample handling; if the reference to toxicity is intended to explain the purpose or required sensitivity of analysis, refer to a radiation protection text.
3001	698	GR	editorial	terminology	15	15.1	15-1	26	Vague. States "scintillation counters". This implies complete systems but I suspect it is intended to mean "scintillation detectors" consistent with instrumentation listed as "detectors" in lines 22-25
3002	699	GR	technical	terminology	15	15.1	15-1	27	"Multichannel analyzers" are a readout component that might be used with any of the three preceding detectors.
3003	700	GR	technical	commentary	15	15.1	15-1	21-27	These lines leave a gap -- gives a variety of detectors but the only electronic package or readout instrument is the multichannel analyzer; it omits scalers and other analyzers. The electronic components or instrumentation that might be found include: (1) Simple counting systems (primarily scalers and ratemeters with simple baseline discriminators), (2) Energy-selective systems such as single-channel analyzers and the 1-, 2-, and 3-channel analyzers commonly found in the simpler liquid scintillation counting systems), and (3) Multichannel spectrometers (incorporating the MCAs of line 27).
3004	701	GR	technical	commentary	15	15.1	15-1	22-27	The bullets are a mixture of detectors (lines 22-25), readout instrumentation (line 27), and complete systems (line 26).
3005	702	GR	editorial	Organization	15	15	15-1	General	Chapter 15 deals with two topics, 1) Instrument calibration and 2) test source preparation. Instrument calibration is intimately linked to Nuclear Counting Instrumentation (Chapter 15); the question arises as to whether it should be part of Chapter 15 (Nuclear Counting Instrumentation). Test source preparation deals with converting the collected and processed samples to a suitable form for introduction to the counting instrument. Test source preparation is the bridge to Chapter 15 (Nuclear Counting Instrumentation) from: Chapter 12, Laboratory Sample Preparation (for samples that need minimal preparation); Chapter 13, Sample Dissolution (for samples that need moderate preparation), and Chapter 14, Separation Techniques (for samples that need radiochemical preparation). The question arises as to whether Test Source Preparation should be a separate chapter either before or following the current Chapter 15. The common thread between the two parts of Chapter 16 (instrument calibration and test source preparati
3006	703	GR	editorial	suggestion	15	15	all	General	Revise the order of presentation and undertake some rewriting. We found that the chapter was confusing or repetitive because it is, in part, an ASTM text that the authors present in reversed order.
3007	704		technical	suggestion	15	15.1	15-1		Flow chart indicating steps and boxes and move boxes to connect sequences. Build a flow chart to show, and place at beginning of Chapter 15.
3008	705	GR	technical	clarification	15	15.1	15-2	38-39	What is the difference between the line 38 "spectrometry (Section15.5)" and the line 39 "spectrometry

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3009	706	GR	technical	commentary	15	15.2, 15.3	15-2	44 ff ... (Section 15.7)?" Sections 15.2 and 15.3 give similar considerations for alpha and beta, respectively, but are written in two different styles.
3010	707	GR	technical	commentary	15	15.2.1	15-2	58-59 "analog-to-digital converters" (line 59) are not used in "all cases" (line 58), only in those systems using multichannel analyzers.
3011	708	GR	technical	suggestion	15	15.2.1	15-3	63 Source diameter is not an independent variable in this list; it is only important as it affects Geometry (line 62) or Self absorption (line 64). Do not hyphenate self absorption.
3012	709	GR	technical	suggestion	15	15.2.1	15-3	71 Suggest inserting "typically" between "counters" and "have". Why "Thus" in the second sentence? This statement does not follow from the preceding one.
3013	710	GR	technical	suggestion	15	15.2.2.1	15-3	80-88 Alpha-counting ion chambers are rather specialized (not just any old ion chamber), and are not too common (see pg 15-24, lines 731-735, discussion of gridded ion chambers, their high efficiency, and being replaced by semiconductor detectors.) This paragraph should start off by giving us a clue as to how they are used and the special considerations.
3014	711	GR	editorial	suggestion	15	15.2.2.2	15-3	89-99 This section should lead off by saying where/how this type of detector is used and in what systems.
3015	712	GR	technical	clarification	15	15.2.2.2	15-4	114-115 Should the efficiency for the windowless flow counter be given (as was done for window flow counter, line 120)?
3016	713	GR	technical	suggestion	15	15.2.2.3	15-4	121-132 This section should lead off with a statement as to where/how scintillation counters are used, in what type of system.
3017	714	GR	editorial	typo	15	15.2.2.3	15-5	129 "vent" should be "event"
3018	715	GR	technical	commentary	15	15.2.2.3	15-5	133 the statement "The counter size is limited by the multiplier phototube size" is not true. Scintillation detectors are commonly the same size as the phototube but there are detectors with light pipes connecting a large size phosphor to a smaller diameter PMT.
3019	716	GR	technical	suggestion	15	15.2.2.3	15-5	133 The convention for using metric notwithstanding, 51 mm PMTs and gas filled detectors were designed as, sold as, and commonly identified as 2-inch detectors. Therefore, in order to tie to conventional usage, I suggest using "51 mm (2 in)" -- here and elsewhere.
3020	717	SB	technical	suggestion	15	15.2.2.4	15-5	156 line 156 mentions planchet preparation, a subject that is not really covered until Chapter 16. At the least, a cross-reference to the appropriate section(s) would help.
3021	718	GR	editorial	suggestion	15	15.2.2.4	15-5	149 ff Sections 15.2.2.4 and 15.3.3 deal with liquid scintillation counting for alpha and beta, respectively. Much of the material is applicable to both but not mentioned in both. Suggest there either be an earlier section on liquid scintillation counting in general or make Section 15.2.2.4 more complete and refer back to this section in 15.3.3.
3022	719	GR	technical	suggestion	15	15.2.2.4	15-5	150-157 This paragraph should include the statement that the sample-scintillator mix is placed in a vial transparent to the emitted light (glass or plastic). Vials are not mentioned until later on pg 15-9, line 265 (in the beta section). The statements in lines 156 and 157 are true but not evident from the information given unless the counting vial is mentioned.
3023	720	GR	technical	commentary	15	15.2.2.4	15-6	160 Quenching is mentioned but not defined. (Later on pg 15-34, lines 1037- 1054 there is a pretty good description of liquid scintillation quenching.)
3024	721	GR	technical	commentary	15	15.2.2.5	15-6	191-193 The comparison here of the semiconductor detector to the gridded ionization chamber is valid but "gridded" and the resolution were not mentioned in the early section on ion chambers -- you have to know more than was given in the earlier section in order to be able to follow this.

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3025	722	GR	technical	suggestion	15	15.3.2	15-8	225	This statement is true if you are gross-beta counting a sample without chemical separation. However, the first paragraph of this section includes radiochemical separation. If there has been complete separation of the radionuclide of interest, gross counting is all you need! The author should have made a distinction between gross activity analysis and gross counting. Furthermore, this statement applies equally to alpha, beta, and gamma and should be in general section rather than only in this beta section.
3026	723	GR	editorial	suggestion	15	15.3.3	15-8	227	See earlier comments re overlap with Section 15.2.2.4.
3027	724	GR	technical	commentary	15	15.3.3	15-8	246	Again quenching is mentioned but is not really defined until later on pg 15-34.
3028	725	SB	technical	suggestion	15	15.3.3	15-9	273	Suggest add "in the medium" after "speed of light".
3029	726	GR	editorial	typo	15	15.3.3	15-9	274	the comma should be a dash.
3030	727	GR	technical	typo	15	15.3.3	15-9	275	"wave shifters" should be "wavelength shifters".
3031	728	SB	editorial	suggestion	15	15.3.3	15-9	278	Suggest add "(see Section 20.1)" after "mixed waste".
3032	729	GR	technical	suggestion	15	15.3.5	15-10	306-308	This is redundant with Section 15.3.1.
3033	730	GR	technical	commentary	15	15.3.6	15-11	323	This is in the beta section, but most of it applies as well to alpha and gamma counting.
3034	731	GR	technical	clarification	15	15.3.6	15-11	324	Do any modern systems still use a mechanical register? Or should this be deleted? This sounds like it was lifted from an old document.
3035	732	GR	editorial	typo	15	15.3.6	15-11	324	Insert a comma after "power supply".
3036	733	GR	technical	commentary	15	15.3.6	15-11	324, 325	A number of system components are named but I don't believe their functions have been given
3037	734	GR	technical	clarification	15	15.3.6	15-11	334-348	This explains the characteristics of and differences between various gas-filled detectors (which were introduced earlier). Is this necessary? If so, it should appear earlier -- before the introduction of ion chamber, proportional, and GM detectors.
3038	735	GR	technical	clarification	15	15.4	15-12	359	Various places in this section present materials applicable to both scintillation detectors (such as NaI) and to semiconductor detectors (such as HPGe), other parts are specific to one or the other; however, this isn't always clear to the uninitiated reader.
3039	736	GR	technical	commentary	15	15.4.1	15-12	361	The statement about non-destructive measurement is not always true and to a certain extent misleading. Yes, relatively non-destructive gamma measurements are made. However, in many cases the sample is processed in some fashion first: e.g., grinding, sieving, ashing, evaporation to reduce volume, ion exchange, etc. Furthermore, gamma counting is also used to count radiochemically separated portion of samples that have been destructively processed.
3040	737	GR	editorial	commentary	15	15.4.1	15-12	371 ff	Abrupt change of thought in the middle of this paragraph.
3041	738	GR	technical	clarification	15	15.4.1	15-12	382 ff	At this point it would be instructive to state that photoelectric events can be used to identify and quantitate specific nuclides in a mixture.
3042	739	GR	editorial	suggestion	15	15.4.1	15-13	389	Change "In solids such as NaI(Tl) or CsI ... " to "In solids such as the scintillation detectors NaI(Tl) or CsI ... ".
3043	740	GR	editorial	commentary	15	15.4.1	15-13	410-422	This is, for the most part, redundant with pg 15-12, lines 371-382.
3044	741	GR	editorial	suggestion	15	15.4.1	15-13	caption	Figure 15.2 caption: Add the words "from Semiconductor Detectors". (The text referring to this figure (called out on line 418) has been talking about both scintillation and semiconductor detectors, but this is very definitely a spectrum from a semiconductor detector.)
3045	742	GR	technical	commentary	15	15.4.1	15-14	441-444	Again a reference to gross counting which has never been well defined in either the beta or the gamma section. You have to be already knowledgeable to follow this.

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	Row	Source	Category	Classification	Chap	Section	Page	Line	Comment
3046	743	GR	editorial	typo	15	15.4.1	15-15	461	"... the data is ..." should be "... the data are..."
3047	744	GR	technical	commentary	15	15.4.1	15-15	457-474	This section introduces a number of technical terms (pulse pileup, rise time, pole zero, etc., but not enough information for them to have meaning to anyone not already knowledgeable.
3048	745	GR	technical	commentary	15	15.4.1	15-15	460-474	This is a laboratory manual, the most practical solution in most cases will be dilution rather than distance, collimation, or detector size. These later solutions are more like to be applied to process line monitoring or to emergency effluent monitoring than to laboratory sample analysis.
3049	746	GR	technical	suggestion	15	15.4.1	15-15	460-474	These high count rate effects are possible for "process", some radioactive waste, and activation analysis samples, but are not likely to be a problem for general environmental samples. The reader should be given a little more guidance on when to be alerted for these effects.
3050	747	GR	technical	suggestion	15	15.4.2	15-16	518	Abrupt jump from HPGe to NaI scintillation. In addition, this sentence doesn't read very well. It would read better if it said something like "The most widely used size of NaI(Tl) detector is the 76 x 76 mm (3 x 3 in)".
3051	748	GR	technical	suggestion	15	15.4.1	15-16	493-496	This is specific to NaI(Tl) scintillation and a sudden switch after previous discussion and figures dealing primarily with HPGe. Similar information should be given for HPGe; especially since this is the detector of choice for resolving complex spectra.
3052	749	GR	technical	suggestion	15	15.4.2	15-16	502-503, Fig 15.4	35% and 70% are not explained; this could easily be confused with absolute efficiency. This explanation does not occur until later on pg 15-26, lines 809-810.
3053	750	GR	technical	clarification	15	15.4.2	15-16	504, 505	What do "vespel well" and "Mg well" mean?
3054	751	GR	editorial	suggestion	15	15.4.2	15-16	518, 523	Suggest putting detector size in inches in parentheses following the metric size -- for same reasons given for pg 15-5, line 133.
3055	752	GR	Technical	commentary	15	15.4.2	15-16		The line codes in the key for figure 15.4 cannot be distinguished. The position order in the key is inverted from the position order in the figure. This is an unnecessary complication for the reader and not good communication.
3056	753	GR	technical	suggestion	15	15.4.2	15-17	540	Table 15.1: The geometries for each of these sample configurations should be more explicitly defined. I assume that the filter paper (column 2), the planchet (column 3), and the AL can (column 4) are placed directly on top of an upright detector.
3057	754	GR	editorial	suggestion	15	15.4.2	15-17	555	Table 15.1: Here the detector size is given in inches without the metric equivalent. Be consistent and also see earlier recommendations re detector size convention.
3058	755	GR	editorial	suggestion	15	15.4.3	15-18	561	how about 76 x 76 mm (3 x 3 in)?
3059	756	GR	technical	clarification	15	15.4.3	15-18	569	States "... gamma ray spectrometer system." However the following description is for a single channel gamma ray spectrometer system and there is no mention of the more preferable multichannel spectrometer system. Was this perhaps adapted from an out-dated reference?
3060	757	GR	technical	commentary	15	15.4.3	15-18	571	First column entry is for Preamplifier but second column gives description of the main amplifier. No column two entry for Preamplifier; no column one entry for main amplifier.
3061	758	GR	technical	suggestion	15	15.4.3	15-18	560 ff	The section title says "Detector Assembly" and the first paragraph deals with the detector. However, the second paragraph deals with all the other components of the system. A more appropriate title would be "Sodium Iodide Counting System."
3062	759	GR	editorial	Organization	15	15.4.3	15-18	572-573	Between lines 572 and 573: Column two entry for sample mounts and containers but no column one entry. (This also screws up the line numbering sequence!)
3063	760	GR	technical	suggestion	15	15.4.4	15-19	576	"None of the configurations of germanium detector .. can be operated at room temperature ..." would

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	Row	Source	Category	Classification	Chap	Section	Page	Line	Comment
3064	761	GR	technical	commentary	15	15.4.4	15-19	590-592	be a better choice of words than "Any type of <u>germanium</u> ... cannot be operated at room temperature ...". This refers to configuration of <u>germanium detector</u> , not type of germanium. Also "No ... can" is less ambiguous than "Any ... cannot". These two sentences pertain to choosing between NaI and HPGe and it seems as though the statement should come earlier. However, I don't have a specific suggestion.
3065	762	GR	technical	Organization	15	15.4.7 to 15.4.9	15-20	612-629	These are three sections (15.4.7, 15.4.8, 15.4.9) on less commonly used scintillation detectors and they seem like orphans. How about grouping all scintillation detectors together in one place and then go on to expand on the more common NaI? Or in a single section, "Other scintillation detectors"?
3066	763	GR	technical	clarification	15	15.4.9	15-21	629	I don't believe "photofraction" has been defined in this document. Should it be?
3067	764	GR	technical	commentary	15	15.5	15-21	630	The title "Spectrometry Systems" is misleading. The most common spectrometry systems were covered earlier; these are special systems.
3068	765	GR	technical	commentary	15	15.5	15-21	631	I dispute the statement "commonly used for gamma-ray spectrometry". Unless I've really lost touch with things, these are uncommon systems! Also "... commonly use ..." should be "... commonly used ..."
3069	766	GR	technical	clarification	15	15.5.4	15-22	661	this needs a reference. (McDowell, 1993?)
3070	767	GR	technical	clarification	15	15.6.2	15-23	683-698	Does this section have any practical significance in this document?
3071	768	GR	editorial	typo	15	15.7	15-24	731	Delete hyphen from ion-chambers.
3072	769	GR	editorial	suggestion	15	15.7	15-24	717 ff	Section 15.7 is redundant with much of the early material but is written more in the style of the rest of MARLAP. This section answers many of the questions raised in reading the earlier sections. It might be worthwhile for the earlier sections to be merged into 15.7. Perhaps much of the overlap and difference in presentation in this chapter could be overcome by reorganizing the chapter
3073	770	GR	editorial	Organization	15	15.7	15-24	718 - 889	This first part of the section should have some subsections (such as for alpha, beta, and gamma) to provide more balance with existing subsections 15.7.1 and 15.7.2, which are really secondary in importance to this earlier material.
3074	771	GR	technical	commentary	15	15.7	15-25	752	This paragraph needs more introduction. Why is it important to know about the Heath spectrum catalogs?
3075	772	GR	technical	clarification	15	15.7	15-26	803, 810	Crystals in inches as well as mm?
3076	773	GR	editorial	commentary	15	15	15-26	General	Starting from this page, the chapter reads very well. This section should be used as a guideline for the earlier parts of the chapter.
3077	774	GR	editorial	suggestion	15	15.7	15-27	828	Crystal in mm as well as in?
3078	775	GR	editorial	typo	15	15.7	15-27	839	Plural "minutes" should be singular "minute".
3079	776	JM	editorial	suggestion	15	15.7	15-27		Figure 15.7: Vertical axis label and peak label are illegible
3080	777	JM	editorial	suggestion	15	15.7	15-27		Figure 15.8: Vertical axis label and peak label are illegible
3081	778	GR	technical	commentary	15	15.7	15-28	847	This sounds like end cap specifications for a low energy detector.
3082	779	GR	editorial	suggestion	15	15.7	15-28	857, 858	76 x 76 mm (4 x 4 in).
3083	780	GR	editorial	typo	15	15.7	15-28	863-864	Incomplete sentence; I suspect one or more lines or line segments got left out.
3084	781	GR	technical	suggestion	15	15.8	15-31	956-959	This paragraph on counter background seems to be an orphan in the Shielding section. This should go earlier in the chapter as a prelude to the various background reduction strategies.
3085	782	GR	technical	clarification	15	15.9	15-31	969-975	Are standards of all radionuclides available from NIST or is it necessary to go out of the country for some? (Ex. IAEA)

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3086	783	GR	editorial	suggestion	15	15.10.1.1	15-32	983 ff	This section is redundant with Chapter 16. It should be deleted.
3087	784	GR	technical	clarification	15	15.10.1.1	15-32	988-989	What is the relevance of this cesium-137 gamma radiation to alpha detection?
3088	785	GR	editorial	typo	15	15.10.1.1	15-33	1014	Need "is" between contamination and dominated.
3089	786	SB	editorial	typo	15	15.10.1.1	15-33	1029	"a-producing" should be "alpha-producing" (Greek letter OK).
3090	787	GR	editorial	commentary	15	15.10.1.1	15-33	1002, 1014	Paragraphs starting lines 1002 and 1014 are redundant.
3091	788	GR	editorial	typo	15	15.10.1.1	15-34	1044	"if" should be "in".
3092	789	GR	technical	clarification	15	15.10.1.1	15-34	1049	This diagram is not very clear. What do the underlined spaces and the vertical lines mean? Are some arrow heads missing?
3093	790	SB	editorial	suggestion	15	15.10.1.1	15-34	1059	Should be "calibration, attenuation . . ."
3094	791	GR	editorial	suggestion	15	15.10.1.1	15-34	1037-1048	Here is the definition of quenching that should be moved to earlier in the chapter.
3095	792	SB	editorial	typo	15	15.10.1.1	15-34	1051-1052	"effected" should be "affected" (two places).
3096	793	GR	editorial	typo	15	15.10.1.2	15-35	1076	Put comma after second "sample".
3097	794	GR	editorial	typo	15	15.10.1.2	15-35	1077	Put semicolon or dash after "made".
3098	795	GR	editorial	typo	15	15.10.1.2	15-35	1082	Put semicolon after "available".
3099	796	SB	editorial	typo	15	15.10.1.3	15-36	1113, 1117	For consistency, "P10" should probably be "(super 10)P".
3100	797	GR	editorial	typo	15	15.10.1.4	15-37	1129	"ore" should be "or".
3101	798	SB	editorial	suggestion	15	15.10.1.4	15-37	1124 ff	line 1124 ff introduces the control chart, but it is not fully discussed with an example until Section 18.3.2. Probably should be a early cross reference, especially to the example chart on p. 18-7.
3102	799	GR	editorial	commentary	15	15.10.1.4	15-39	1183 ff	The writing suddenly become very specific and prescriptive.
3103	800	GR	technical	commentary	15	15.10.2.1	15-40	1232-1240	"Gross" activity measurement is a little better described here. (See comments for page 15-8, lines 225-226, and for page 15-14, lines 441-444)
3104	801	JM	editorial	typo	15	15.10.2.2	15-41	1267	Change "large" to "larger"

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3105	802	GR	editorial	typo	15	15.10.2.2	15-41	1267	Insert "to" after "rise".
3106	803	GR	editorial	typo	15	15.10.3.1	15-46	1413	"See page 51..." should be "See page 15-51 ..."
3107	804	GR	editorial	typo	15	15.10.3.1	15-46	1413	"... list items ..." should be "... list of items ..."
3108	805	GR	editorial	suggestion	15	15.10.3.1	15-46	1419	NIM should be defined in "poorly conditioned NIM power"
3109	806	GR	technical	suggestion	15	15.10.3.1	15-47	1431	Equation 15.1 needs a lead in.
3110	807	GR	editorial	suggestion	15	15.10.3.1	15-47	1443	End this line with a colon as a lead in to eqn 15.2?
3111	808	GR	technical	clarification	15	15.10.3.1	15-47	1431-1450	And what are you supposed to do with the results of these equations? (eqns 15.1 to 15.3)
3112	809	GR	editorial	suggestion	15	15.10.3.4	15-50	1522	75 x 75 mm (3 x 3 in)
3113	810	GR	editorial	typo	15	15.10.3.5	15-51	1566	"nim" should be "NIM"
3114	811	GR	technical	clarification	15	15.10.4.1	15-52	1586, 1588	Shouldn't "234U" be "233U"? Spike is 233U (line 1585).
3115	812	GR	editorial	typo	15	15.10.4.2	15-53	1626	"signal" should be "signals" to match "they" in line 1627.
3116	813	GR	technical	clarification	15	15.10.4.3	15-54	1651	neutron flux is in "n", not "ng". Is the notation "n/cm2/s" consistent with the rules for this publication?
3117	814	GR	technical	clarification	15	15.10.4.3	15-54	1662	neutron flux is in "n", not "ng". Is the notation "n/cm2/s" consistent with the rules for this publication?
3118	815	GR	technical	suggestion	15	15.10.4.3	15-55	1672	"Neutron Activation analysis method was employed..." should be either "The Neutron Activation Analysis method was employed..." or "Neutron Activation Analysis was employed..."
3119	816	GR	editorial	typo	15	15A.2	15-64	1909	insert "a" after "as".
3120	817	GR	technical	Organization	15	15	All		In this chapter, wouldn't it be more efficient to describe proportional counters and scintillation counters (or even each of the various types of detectors) first and then go to specific radiation types, and thus avoid having to repeat the description for each type of radiation?
3121	818	GR	technical	Organization	15	15A	All		Is any of this redundant with other Chapters on calibration of QA?
3122	819	GR	technical	suggestion	16	16	All		Chapter 16 addresses standard reference materials (usually solution standards) which are used to make up instrument calibration standards. Also important are the matrix-specific reference materials that are used to check for recoveries from various matrices and to QA for matrix-specific effects in sample preparation, dissolution, and separation. Does this document address this in any place? Several examples include: (1) NIST Environmental Natural Matrix Standard (various analyzed samples of soils, sediments, human tissue, and shellfish) and (2) IAEA AQCS Reference Materials for the

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3123	820	GR	technical	clarification	16	16	All	Determination of Radionuclides: (a) Biological Materials of Marine Origin - Fish and shellfish, (b) Biological Materials of Terrestrial Origin - Milk and dairy products, grass, other vegetation, bone, (c) Non-biological materials of Marine Origin - Sediments, and (d) Non-biological materials of Terrestrial Origin - Soil and lake sediments. It is not clear what is the role for commercial, plated alpha and beta sources, particularly for alpha spectrometry. What are the considerations, cautions, correction factors, etc. if a laboratory chooses to purchase these sources rather than custom making sources from calibrated solutions?
3124	821	GR	editorial	commentary	16	16	All	Chapter 16 seems to be straight forward and unambiguous with a good balance between the general performance and the prescriptive.
3125	822	GR	editorial	commentary	16	16	All	Some of the instrument descriptions in this chapter are better than the ones in Chapter 15.
3126	823	GR	editorial	Organization	16	16	All	There are a number of instances with overlap with other chapters; however, this probably cannot be avoided.
3127	824	G2	editorial	Organization	16	16	All	Integrate with chapters 12 – 15 by suitable references in these preceding chapters to the pertinent discussions in chapter 16.
3128	825	SB	editorial	Organization	16	16	All	I was surprised that Chapter 16 (which includes advice on test source preparation) came before Chapter 15 (which covers counting after the source has been prepared)
3129	826		technical	suggestion	16	16	All	Chapter flows well as written, so leave chapters as they are but do better road map on what this section is all about and how the Chapters 15, 16 are interrelated.
3130	827	GR	technical	clarification	16	16.2.2	16-3 76	Is there another word that can be used instead of "Correspondence"? (congruity, harmony, harmonization, etc.?) It is a perfectly good word for what it is meant here, but it conjures up the image of mail or e-mail.
3131	828	GR	technical	suggestion	16	16.3.3	16-6 161	Show how this scattering/self-absorption factor is used (give a correction equation?).
3132	829	SB	technical	commentary	16	16.3.4	16-8 232-234	uses "inch" to describe planchet size. I'm OK with that, but it's not SI.
3133	830	GR	editorial	suggestion	16	16.4.1.2	16-11 311-318	If this is not mentioned in Chapter 15, it should be.
3134	831	GR	editorial	commentary	16	16.4.2	16-11 333-335	Redundant with what is (or should be) in Chapter 15; but that's probably alright.
3135	832	GR	technical	suggestion	16	16.5.1	16-14 413-414	Insert "such as 89Sr and 90Sr" just after "... not accompanied by a gamma ray". Delete "89Sr and 90Sr" from their present position and leave the rest of the radionuclides where they are.
3136	833		technical	typo	16	16.5.2	16-15 462	Shouldn't "aliquant" be "aliquot"? (same question arises in other parts of this chapter)
3137	834	GR	technical	commentary	16	16.5.2.1	16-16 500-507	Quenching was discussed in Chapter 15, but this is a much better description.
3138	835	GR	technical	clarification	16	16.5.2.1	16-17 530	Should "... channels ratio" be "... channels ratio method"?
3139	836		technical	typo	16	16.5.2.1	16-17 524-526	Shouldn't "aliquant" be "aliquot"? (same question arises in other parts of this chapter)
3140	837		Technical	commentary	16	16.6.1	16-18 557-562	Here is some bridge material from Chapters 12 and 13.
3141	838		Technical	commentary	16	16.6.1	16-19 589-597	More bridge material from earlier chapters.
3142	839	GR	editorial	typo	16	16.7.1	16-20 615	Insert "alpha" between High-resolution and spectroscopy.
3143	840		technical	typo	16	16.7.3	16-25 771	Shouldn't "aliquant" be "aliquot"? (same question arises in other parts of this chapter)
3144	841	SB	technical	clarification	16	16.7.5	16-27 844	Why isn't radon in this list?
3145	842	GR	technical	suggestion	16	16.7.5	16-27 844	Add the isotopes of Rn to the list of radioactive noble gases.
3146	843	GR	technical	suggestion	16	16.7.5	16-27 851, 852	"Media" should be "medium" (singular); insert "or" before "peroxide"; substitute for the final clause "with the medium then analyzed by scintillation spectrometry".
3147	844	SB	technical	commentary	16	16.7.5	16-28 890	Another instance of non-SI units (cfm)

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3148	845	GB	technical	commentary	17	17	All		Many of the terms and acronyms were poorly explained.
3149	846	GB	Technical	commentary	17	17	All		Many of the units associated with terms from the equations are inconsistent from one equation to the next.
3150	847	GB	editorial	commentary	17	17	All		Several Figures are unclear due to small font size or poor contrast (fig 17.3, Fig 17.4, Fig 17.5).
3151	848	GB	editorial	commentary	17	17	All		On another note, I found the text to be very well written with the exception of some repetitions and redundancies. I would like to compliment the author(s) on a thorough job for this Chapter.
3152	849	GB	editorial	suggestion	17	17	All		There appear to be typos in some of the equations. In any case, all equations need to be thoroughly checked throughout the document.
3153	850	GB	editorial	format	17	17	All		Many of the references both in the text and in the Reference section are incomplete, missing or wrong. All references should be thoroughly checked and a format common to the entire MARLAP manuscript should be adopted.
3154	851	GB	Technical	Clarification	17	17.1	17-2	46	Change of text: '...assist in the data validation process (Chapter 8). Support material can include information on...'
3155	852	GB	Technical	Clarification	17	17.2	17-2	54	Addition of text: 'Data acquisition in this context, refers to the process of collecting the basic information produced by nuclear...'
3156	853	GB	Technical	Clarification	17	17.2	17-2	61	Deletion of text: '...transferred to the next data-reduction step. Electronic transfer should be employed as...'
3157	854	GB	Editorial	Reference	17	17.1	17-2	40, 988	Correction of reference: '(ANSI 42.23, 1996; p.38):'
3158	855	GB	Editorial	Typo	17	17.2.1	17-3	88	Addition of letter s: '...parameter adjustments may be required for some or all of the samples received. The number of...'
3159	856	GB	Technical	Clarification	17	17.2	17-3	62, 63	Addition of comma, /modification of text: '...often as possible, to avoid the inherent errors associated with manual transfer. On the other hand, electronic transfers need to be scrutinized, so as to assure that the data is not corrupted. Following this procedure, the next step in the data reduction process may be performed manually, i.e., with a calculator.'
3160	857	SB	technical	suggestion	17	17.2.1.1	17-4	118	I initially stumbled on "proportional" because I tend to think of uncertainty as relative (e.g., percent uncertainty) and wanted to insert "inversely". I now recognize that the statement is accurate, but maybe you want to add "absolute" before "uncertainty" on line 117, and even add a sentence: "The relative uncertainty is therefore inversely proportional to the square root of n."
3161	858	GB	Technical	Clarification	17	17.2.1.3	17-6	159	Addition of word: 'The output of some instruments is very basic, primarily counting data, i.e., total counts or counts per...'
3162	859	GB	Technical	Clarification	17	17.2.2	17-7	191	Change of text: 'tc = real time (actual clock time) of counting...'
3163	860	GB	Technical	Clarification	17	17.2.2	17-7	192	Deletion of superscript 2: 'This calculates the radionuclide concentration at the time of sample collection. It compensates...'
3164	861	GB	Technical	Clarification	17	17.2.2	17-7	194	Addition of superscript 2: '...counting, when the counting duration is a significant fraction of the half-life ² . For long-lived...'
3165	862	GB	Editorial	Typo	17	17.3	17-8	215	Deletion of letter s: '...for these purposes and can be applied to the analysis of a wide range of radionuclides. Energy...'
3166	863	GB	Editorial	Typo	17	17.3	17-8	228	Deletion of letter d: '...Sanderson, 1992). A method of performance...'
3167	864	GB	Editorial	Reference	17	17.3	17-8	229	Change in reference: 'ANSI N42.14 (1991).
3168	865	GB	Editorial	typo	17	17.3.1	17-9	258 ff	Deletion of letter m: '...Gilmore and Hemingway, 1995...' (lines 258, 314, 320, 326, 343, 363, 368, 403, 515, 522, 541)

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	Row	Source	Category	Classification	Chap	Section	Page	Line	Comment
3169	866	GB	Technical	Format	17	17.3.1	17-9	Figure 17.1	Gamma-ray spectrum: index the photopeaks P1 and P2 as referred to in the text, lines 266-267.
3170	867	GB	Editorial	Format	17	17.3.1	17-11	Figure 17.2	Gamma-ray analysis sequence: enlarge figure so that the entire width of the page is taken advantage of. This will allow to represent the boxes labeled "Report", "Calculate Uncertainty", "Concentration", "Resolve", etc... as larger, and dispose of flow chart in a clearer way.
3171	868	GB	Technical	Clarification	17	17.3.1.1	17-12	309-310	Addition of text: 'As previously stated, the photopeak has a basic Gaussian shape; in reality it is a histogram with a Gaussian-like shape, unless interference effects are present as in a multiplet.'
3172	869	GB	Technical	Clarification	17	17.3.1.4	17-14	386	Addition of text: '...normally quoted in terms of its full width at half maximum or FWHM (c.f., Chapter 18, section 18.5.3.2.). For a discussion...'
3173	870	GB	Technical	Format	17	17.3.1.4	17-16	Figure 17.3	Low-energy tailing: Clean-up this figure so that the information beneath the spectrum is clearly visible and highlighted, i.e., "FWHM", "DC", etc...Increase the font size of the abscissa and ordinate headers.
3174	871	GB	Technical	Format	17	17.3.1.5	17-17	Figure 17.4	Photopeak baseline continuum: Increase the overall size of figure or increase the font size of the text.
3175	872	GB	Editorial	Clarification	17	17.3.1.8	17-20	504	Deletion of word is: '...time, and (2) true coincidence summing, due to the simultaneous emission of gamma-rays by a...'
3176	873	GB	Editorial	Grammar	17	17.3.1.8	17-21	509	Addition of comma, (2x): 'having a count in both full-energy peaks, a count will occur somewhere else in the spectrum, equal...'
3177	874	GB	Editorial	Grammar	17	17.3.1.8	17-21	511	Addition of comma : '...interactions, e.g., photoelectric with Compton, and Compton and Compton. Since this occurs...'
3178	875	GB	Editorial	Reference	17	17.3.1.8	17-21	522	Correction of reference: '...If unknown, the resolving time can be estimated by a method similar to that described in Gilmore and Hemingway (1995).'
3179	876	GB	Editorial	Typo	17	17.3.2	17-23	582	Deletion of letter s: '...to have alpha spectrometry software to identify radionuclides, subtract background, perform...'
3180	877	GB	Technical	Clarification	17	17.3.2	17-24	606	Addition/modification of text: '...counts, a region of interest or ROI-type analysis is usually performed. However, peak fitting programs are...'
3181	878	GB	Editorial	Typo	17	17.3.2	17-27	683	Deletion of letter n: 'The FWHM of a given peak may depend greatly on the source preparation. However, since a...'
3182	879	GB	Editorial	Reference	17	17.3.3.1	17-29	746	Correction of references: '...developed over the years (Holm et al., 1984; Harvey and Sutton, 1970).'
3183	880	GB	Technical	Clarification	17	17.3.3.3	17-30	773	Deletion of word of: '...decay pulse are the basis for discrimination alpha particles from beta and gamma radiation in...'
3184	881	GB	Editorial	Grammar	17	17.3.3.8	17-32	824	Addition of comma, : '...counter efficiency ⁴ . If the internal (standards addition) method is used, the data generated by the...'
3185	882	SB	technical	clarification	17	17.3.3.8	17-32	829	On pages 17-6 and 17-7, the notation C(sub net) is used for the difference of C(sub G) and C(sub B). Why not here (Eqn 17.21) and in the next two equations (17.22 and 17.23)? Or do I misunderstand?
3186	883	GB	Technical	Suggestion	17	17.3.3.8	17-32	833	Change of units : "epsilon _{sub q} = the radionuclide quench corrected counting efficiency (cps/dps)" [instead of "c/d"]
3187	884	GB	Technical	Suggestion	17	17.4	17-33	857	Change of units: 'epsilon = the gross or radionuclide counting efficiency cps/dps)' [instead of "c/d"]
3188	885	GB	Technical	Clarification	17	17.4	17-34	Equation 17.26	Equation 17.26: The second term of the equation [Summation] m ^{2i} u ^{2} (a _{sub i}) appears to be incorrect and should read: [Summation] m ^{i} u ^{2} (a _{sub i}) (I.e., the m term should be raised to the power of i, not 2i)

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	Row	Source	Category	Classification	Chap	Section	Page	Line	Comment
3189	886	GB	Technical	Format	17	17.5.2	17-38	Table 17.1	Units For Data Reporting: Generalize this type of Table so that can be used throughout the MARLAP document. In this way, where applicable, similar data can be captured everywhere, for each MARLAP Chapter.
3190	887	GB	Editorial	Format	17	17.5.2	17-38	Table 17.1	An attempt at respecting the same "Title" format as the Figures in this Chapter and indeed throughout the document would also be preferable: e.g., Table 17.1-Units for data reporting
3191	888	GB	Editorial	Reference	17	17.5.4	17-39	988	Correction of reference: '(ANSI 42.23, 1996; p.38):'
3192	889	SB	technical	suggestion	17	17.5.4	17-39	989 ff	Shouldn't the output charts of spectrometers also be provided on request? I'd like to see visually what was counted as a peak and what was not.
3193	890	GB	Editorial	Reference	17	17.8.1	17-41 to - 42	1039-1082	Cited References. Several references cited in the text, are not in this section but are mistakenly cited in the section 17.8.2 Other Sources. These need to be taken out of the latter and included in the former section (i.e., 17.8.1).
3194	891	GB	Editorial	Reference	17	17.8.1	17-41 to - 42	1039-1082	Nearly all references are incomplete and some do not even have publication dates let alone page numbers.
3195	892	GB	Editorial	Reference	17	17.8.1	17-41 to - 42	1039-1082	The format of the reference sections is variable to non-existent. Suggest that a common format be adopted for all references throughout the MARLAP document.
3196	893	GB	Editorial	Reference	17	17.8.1	17-41 to - 42	1039-1082	Suggest that all references in text be accompanied by the date of publication to distinguish various publications.
3197	894	GB	Editorial	Reference	17	17.8.2	17-42 to - 44	1083-1134	Several References in this "Other Sources" section are cited in the text and should be transferred to section 17.8.1. These include:
3198	895	GB	Editorial	Reference	17	17.8.2	17-43	1091-1092	Debertin, K. and Helmer, R.G., 1988...This reference belongs between lines 1045 and 1046 of section 17.8.1.
3199	896	GB	Editorial	Reference	17	17.8.2	17-43	1104-1105	Harvey, B.R., and Sutton, G.A., 1970... This reference is full of typos.
3200	897	GB	Editorial	Reference	17	17.8.2	17-43	1104-1105	This reference belongs between lines 1057 and 1058 of section 17.8.1.
3201	898	GB	Editorial	Reference	17	17.8.2	17-43	1106-1107	Holm, E., Rioseco, J., and Garcia-Leon, M., 1984...This reference is incorrect in the section. The correct reference is cited in section 14.11, p. 14-212, lines 6248-6249,
3202	899	GB	Editorial	Reference	17	17.8.2	17-43	1106-1107	This reference belongs between lines 1060 and 1061 of section 17.8.1.
3203	900	GB	Editorial	Reference	17	17.8.2	17-44	1122	Quittner, P., 1972...This reference is incomplete (needs page numbers).
3204	901	GB	Editorial	Reference	17	17.8.2	17-44	1122	Reference belongs between lines 1079 and 1080 of section 17.8.1.
3205	902	GB	Editorial	Reference	18	18.1	18-1	11	Correction of reference: '...laboratory. General requirements for testing laboratories can be found in ISO/IEC 17025 (1999).
3206	903	GB	editorial	commentary	18	18	All		This Chapter was very well written and the presentation of the material was very accessible. Again, I would like to compliment the author(s) on a thorough job for this Chapter.
3207	904	GB	editorial	format	18	18	All		The greatest problem resides in the presentation of the references in the text, which should be accompanied by a date of publication to distinguish these from earlier versions of the same documents. Reference section needs work and the format needs to be consistent throughout the

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3208	905	GB	editorial	typo	18	18	All		section as well as throughout the MARLAP document (i.e., from Chapter to Chapter).
3209	906	GB	Technical	Commentary	18		All		Check Figures and Tables for typos
									All equations in this Chapter are straight forward and appear to be correct, however the indexing of the equations should be modified from: (1), (2), (3), etc... to: (18.1), (18.2), (18.3), etc, to match other Chapters.
3210	907	GB	Editorial	Reference	18	18.3.2	18-6	156	Correction of reference: ‘...almost any distribution (ISO 8258, publication date). However, when data obtained from radiation counters are...’
3211	908	GB	Editorial	Reference	18	18.3.2	18-6	164	Correction of reference: ‘...ASTM D6299 (2000). Standard Practice for Applying Statistical Quality Assurance Techniques to...’
3212	909	GB	Editorial	Reference	18	18.3.2	18-6	166	Correction of reference: ‘...ASTM E882 (publication date). Standard Guide for Accountability and Quality Control in the Chemical...’
3213	910	GB	Editorial	Reference	18	18.3.2	18-6	169	Correction of reference: ‘...ISO 7870 (publication date). Control Charts—General Guide and Introduction.’
3214	911	GB	Editorial	Reference	18	18.3.2	18-6	170	Correction of reference: ‘...ISO 7873 (publication date).. Control Charts for Arithmetic Average with Warning Limits.’
3215	912	GB	Editorial	Reference	18	18.3.2	18-6	171	Correction of reference: ‘...ISO 7966 (publication date). Acceptance Control Charts.’
3216	913	GB	Editorial	Reference	18	18.3.2	18-6	172	Correction of reference: ‘...ISO 8258 (publication date). Shewhart Control Charts.’
3217	914	GB	Editorial	Reference	18	18.3.2	18-7	173-174	Correction of reference: ‘...American Society for Testing and Materials (ASTM) MNL 7. 1990. Manual on Presentation of Data and Control Chart Analysis ASTM Manual Series, 6th Edition, 1990.’
3218	915	GB	Editorial	Suggestion	18	18.4.1	18-12	321	Addition of text: ‘...should be checked, and batches identified by serial number. When a sudden, significant increase in the blank occurs in conjunction...’
3219	916	GB	technical	Suggestion	18	18.4.1	18-12	Figure 18.2	Three general categories of blank changes: Add under the heading RAPID CHANGES a bullet for INTRODUCTION OF NEW REAGENT BATCH OF DIFFERENT COMPOSITION.
3220	917	GB	Technical	Suggestion	18	18.4.1	18-12	Figure 18.2	Under the heading HIGH VARIABILITY one could add SAMPLE HETEROGENEITY.
3221	918	GB	Editorial	Clarification	18	18.4.4	18-20 & 21	Table 18.2c	Uncertified Massic activities.....: Need to specify under the heading Half Life whether the values are in minutes, hours, or days for the elements 129I, 155Eu, 210Pb, 234U, 235U, 237Np, 238U, and 241Am.
3222	919	GB	Editorial	Format	18	18.4.4	18-20 & 21	Table 18.2c	An attempt at respecting the same “Title” format as the Figures throughout the MARLAP document would also be preferable.
3223	920	GB	Technical	Terminology	18	18.4.4	18-20	Tables 18.2a, b, c	All need to have the uncertainty changed from "Mean +/- 2s{sub m}" and "Half-Life +/- 1s" , changed to either "Mean +/- 2s{sub m}" and "Half-Life +/- 2s" or "Mean +/- 1s{sub m}" and "Half-Life +/- 1s" (i.e., should be consistent in size of uncertainty used in all columns of all tables)
3224	921	SB	editorial	suggestion	18	18.4.5	18-23		Figure 18.4: Suggest removing "Excursions" from title box for consistency with other charts.
3225	922	GB	Editorial	Reference	18	18.5	18-25	711	Correction of reference: ‘...specific techniques, see Chapters 15 and 16 as well as ASTM standard practices (e.g., ASTM D3648, (1995), for...’
3226	923	GB	Editorial	Reference	18	18.5.1	18-26	756	Correction of reference: ‘...performed on a real time basis. See ASTM E18 (publication date), ANSI N42.12 (publication date), and NELAC (2000) Quality...’
3227	924	GB	Editorial	Reference	18	18.5.2	18-28	813	Correction of reference: ‘...instrument dead time is not significant and gain shifts do not occur (ANSI 42.23, 1996). For detection...’

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	Row	Source	Category	Classification	Chap	Section	Page	Line	Comment
3228	925	GB	Editorial	Reference	18	18.5.2	18-28	830	Correction of reference: ‘...fraction of the emissions from the source actually reach the detector (ANSI N15.37, 1981).’
3229	926	GB	Editorial	Reference	18	18.5.2	18-29	835	Correction of reference: ‘...sample container, detector housing and shielding (NCRP 58, 1985).’
3230	927	SB	Technical	clarification	18	18.5.3.2	18-35	1030	Would this be clearer if you inserted "the energy at" before "the most probable peak height"? Or do I misunderstand?
3231	928	GB	Technical	Clarification	18	18.5.4.2	18-40	1181	Addition of text: ‘...electroplated sources, crosstalk may be as low as 1 percent for betas in the alpha channel and 3...’
3232	929	SB	editorial	suggestion	18	18.5.6	18-41	1216	Change to "readers" to agree with "their".
3233	930	GB	Editorial	Terminology	18	18.5.6	18-41	Table 18.5	Instrument calibration: example frequency and performance criteria: Under the heading Performance Criteria, under Initial Calibration, one needs to replace the uncertainty (2s) by uncertainty (2s).
3234	931	GB	Editorial	Reference	18	18.5.6	18-42	1218	Correction of reference: ‘...given in ASTM E181 (publication date) and ANSI N42.12 (publication date).’
3235	932	GB	Editorial	Reference	18	18.5.6	18-43	Table 18.5	Instrument calibration: example frequency and performance criteria: At the base of the Table, on the bottom left, Sources should read: ASTM E181 (date of publication); ANSI N42,12 (date of publication).
3236	933	GB	Editorial	Reference	18	18.6.7	18-54	1615	Correction of reference: ‘...service. Ordinarily, ASTM E617 (1997) Class 1 or 2 weights are used to perform the daily calibration...’
3237	934	GB	Editorial	Reference	18	18.6.7	18-54	1631	Correction of reference: ‘...specified in ASTM E542 (2000). Typically calibrations use volumes of water and are gravimetrically...’
3238	935	GB	Editorial	Reference	18	18	18-55 to - 57	1642-1710	Cited Sources, Section 18.7.1: Many of the references are incomplete and some do not even have publication dates let alone page numbers. The format of the reference section is variable. Suggest that a common format be adopted for all references throughout the MARLAP document. Suggest that all references in text be accompanied by the date of publication to distinguish various publications. Several references in this section are not referred to in the body of the text and need to be moved to section 18.7.2 Other Sources.
3239	936	GB	Editorial	Reference	18	18.7.1	18-55	1643-1645	American National Standards Institute/International Standards Organization/American Society for Quality Control (ANSI/ISO/ASQC) A3534-2. (publication date).
3240	937	GB	Editorial	Reference	18	18.7.1	18-55	1649-1650	American National Standards Institute (ANSI) N1.1. (1976).
3241	938	GB	Editorial	Reference	18	18.7.1	18-56	1679-1680	International Standards Organization (ISO) 7873. (publication date).(date).
3242	939	GB	Editorial	Reference	18	18.7.1	18-57	1701-1702	National Bureau of Standards (NBS). 1964.
3243	940	GB	Editorial	Reference	18	18.7.1	18-57	1703-1704	U.S. Environmental Protection Agency (EPA). 1977.
3244	941	GB	Editorial	Reference	18	18.7.1	18-57	1705-1707	U.S. Environmental Protection Agency (EPA). 1980.
3245	942	GB	Editorial	Reference	18	18.7.2	18-57 to - 58	1711-1723	Other Sources: Many of the references are incomplete and some do not even have publication dates let alone page numbers.
3246	943	GB	Editorial	Reference	18	18.7.2	18-57 to - 58	1711-1723	The format of the reference section is variable. Suggest that a common format be adopted for all references throughout the MARLAP document.

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	Row	Source	Category	Classification	Chap	Section	Page	Line	Comment
3247	944	GB	Editorial	Reference	18	18.7.2	18-57 to -58	1711-1723	Several references in this section are missing and are located in the other section (i.e., section 18.7.1), see above.
3248	945	GB	Editorial	Format	18	18A	18-59		as in Chapter 18, the indexing of the equations needs to be modified so as to be similar to that used in other Chapters. Otherwise these sections are very well presented.
3249	946	GB	Editorial	Reference	18	18A	18-61	1768	Correction of reference: '...moving range (ASTM D6299, 2000,; ASTM E882, publication date). The moving range (MR) is the absolute value of...'
3250	947	GB	Editorial	Reference	18	18A	18-65	1838	Correction of reference: '...Analysis (ASTM MNL7, 1990), as well as many other references.
3251	948	GB	Editorial	Reference	18	18A	18-65	1855	Correction of reference: '...give no more than 1 percent Poisson counting uncertainty (ANSI N42.23, 1996). In other words, at...'
3252	949	GB	Editorial	Reference	18	18A	18-70	1955-1956	American National Standards Institute (ANSI) N42.23, 1996. Measurement and Associated Instrumentation Quality Assurance for Radioassay Laboratories. 1996.
3253	950	GB	Editorial	Reference	18	18A	18-70	1955-1996	Many of the references are incomplete and some do not even have publication dates let alone page numbers.
3254	951	GB	Editorial	Reference	18	18A	18-70	1955-1996	The format of the reference section is variable. Suggest that a common format be adopted for all references throughout the MARLAP document
3255	952	GB	Editorial	Reference	18	18A	18-70	1955-1996	Suggest that all references in text be accompanied by the date of publication to distinguish various publications.
3256	953	GB	Editorial	Reference	18	18A	18-70	1958-1960	American Society for Testing and Materials (ASTM) D6299, 2000.
3257	954	GB	Editorial	Reference	18	18A	18-70	1961-1962	American Society for Testing and Materials (ASTM) E882, (publication date)
3258	955	GB	Editorial	Reference	18	18A	18-70	1963-1964	American Society for Testing and Materials (ASTM) MNL 7, 1990.
3259	956	GB	Technical	Commentary	18	18B	18-71		With the exception of the equation indexing there are no problems with the References either in the body of the text or in the Reference section itself. The Problems and their solutions are well presented and the section is very useful as an illustration of additional statistical methods available to the user of control charts.
3260	957	GB	technical	commentary	18	18A	18-59		Attachments 18A and 18B are very useful additions to Section 18.3.2. Statistical Means of Evaluating Performance Indicators-Control Charts. More specifically attachment 18A served as a guide to the various control charts and their use in the statistical evaluation of data sets. I did not take it upon myself to verify the solutions to the problems given in the section and suggest that this be done using an internal QA procedure for all statistical and numerical problems and equations throughout the MARLAP document.
3261	958	GB	technical	commentary	18	18B	18-71		Attachment 18B. No comments for this Attachment. With the exception of the equation indexing there are no problems with the References either in the body of the text or in the Reference section itself. The Problems and their solutions are well presented and the section is very useful as an illustration of additional statistical methods available to the user of control charts.
3262	959	SB	technical	suggestion	19	19.2.1	19-3	62	Page 19-7 makes it clear that "distribution function" is the same as "cumulative distribution function" (CDF) for those of us who are used to the more complete wording. Maybe it should be said here, too.

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	Row	Source	Category	Classification	Chap	Section	Page	Line	Comment
3263	960	SB	technical	clarification	19	19.2.1	19-3	89 ff	The discussion of mode seems incomplete. If mode means most likely value, then every point in a rectangular distribution would be a mode. To me, mode means a local peak in the density function. Then it is then easy for a function to be multi-modal without the peaks all being the same height.
3264	961	G3	technical	clarification	19	19.2.1	19-4	95	The median is unique except for the case where you have two non-overlapping segments. That is, if the likelihood is positive everywhere, the median is unique. Do we really need this sentence?
3265	962	SB	technical	commentary	19	19.2.1	19-4	95	How can the median not be unique? Isn't it where the monotonic CDF crosses 50%? Of course, a distribution could say that no values between x and y are possible, and that x just happens to be at the 50% mark of the CDF, but is that realistic for radioanalytic measurements?
3266	963	G3	Technical	clarification	19	19.2.1	19-5	106-111	What do these lines mean? Correlated with respect to what?
3267	964	G3	editorial	suggestion	19	19.2.1	19-5	122-127	Use language that is more colloquial, with presentations of concepts that will be easier to understand by the target audience. For example, the presentation of statistical independence vs. correlation provided on page 19-5 lines 122-127 is unnecessarily complicated and probably not even necessary.
3268	965	G3	technical	commentary	19	19.2.2	19-6	158	Mode is non-rigorous - it is really a local maximum of the PDF - which is how we get multi-modal distributions.
3269	966	G3	technical	clarification	19	19.2.2	19-6	147-148	Estimator is defined as follows: "A random variable whose value is used to estimate an unknown parameter p is called an estimator for p". The definition as presented implies that only random variables are estimators. It would seem that some estimators may be deterministic.
3270	967	G3	technical	clarification	19	19.2.2	19-6	149-151	Related to the expectation value, it is stated that "X, is a measure of the center of its distribution" referring to the distribution of random variable X. For discrete distributions, this definition is problematic. Consider for example a random variable X that takes on a value of 1 with probability p (where $0 < p < 1$) and takes on a value of 0 with probability $1-p$. In the case where $p=0.6$, $X = 0.6(1) + 0.4(0) = 0.6$; a value not found among the values for X (only values of 0 or 1 can occur). Thus 0.6 does not represent the middle of the distribution for actual values taken on by X.
3271	968	G3	technical	suggestion	19	19.2.2	19-6	149-151	"Expectation" is used instead of "expectation value". It seems that expectation value would be more appropriate.
3272	969	G3	technical	suggestion	19	19.2.2	19-7	160-162	The definition for the "probability density function" as presented seems to exclude discrete distributions. The presented definition also does not help with distributions that cannot be adequately characterized using formal mathematical expressions (e.g. formal distribution functions such as normal and lognormal). It would be helpful to add a general definition of the "probability density" as it relates to discrete and continuous random variables. It would also be helpful to add definitions of unimodal and multimodal distributions.
3273	970	G3	technical	commentary	19	19.2.2	19-7	165-166	Random variable is defined as follows: "A random variable is the numerical outcome of an experiment which produces varying results when repeated." Random variables are not restricted to experiments.
3274	971	G3	editorial	clarification	19	19.3.1	19-8	206	What's a "GUM"? Add to Glossary?
3275	972	G3	editorial	suggestion	19	19.3.1, 19.3.2	19-8	181-237	Edit sections 19.3.1 and 19.3.2 for brevity and clarity
3276	973	G3	technical	clarification	19	19.3.3	19-10	261	Type A and B: all that is not A is B - nice definition. For type B you make a best guess?
3277	974	SB	technical	clarification	19	19.3.3	19-10	241 ff	I don't fully appreciate the difference between u and sigma. Is the point that the uncertainty u describes your lack of confidence in a specific measurement while sigma describes the variability of the measurement process? Perhaps a few more words on this point.

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	Row	Source	Category	Classification	Chap	Section	Page	Line	Comment
3278	975	SB	technical	clarification	19	19.3.8	19-13	333-334	I've always been a bit uncomfortable about the notation $y \pm u$ for environmental measurements. It seems to imply a symmetric distribution, where the probability of an outcome less than $y-u$ is exactly the same as the probability of an outcome more than $y+u$. But that doesn't hold for asymmetric distributions, does it? Although I know I am battling decades or even centuries of tradition, maybe we should ask for a little more explanation.
3279	976	SB	technical	suggestion	19	19.4.2	19-19	521 ff	I continue to find the issue of the MDC vs. the critical value difficult to understand intuitively. For example, I don't understand why the distribution on the right of Figure 19.3 shows more dispersion than the one on the left. I still struggle with the difference between the critical value and the MDC, although I do understand that the former is based on α and the other on β . It might be clearer to say (if true!) that the critical value is more important when the null hypothesis is that the sample is not contaminated, while the MDC is more important when the null hypothesis is the opposite.
3280	977	G3	technical	suggestion	19	19	19		Another relatively powerful test for normality is discussed in: Dallal, G.E. and L. Wilkinson. 1986. An analytic approximation to the distribution of Lilliefors test statistic for normality. American Statistician. 40: 294-296
3281	978	G3	editorial	suggestion	19	19	19		Overall impression of Chapter 19 main body - it is idiosyncratic. That is, it goes into great detail on stuff that may or may not be important and uses very general forms of equations that may not apply to the real world. A lot of effort goes into "uncertainty" calculations - but unless we assume normality it is hard to see what to do with the results. I'd like to see it start with counting statistics (page 19-44) and then proceed through a series of problems that treat typical or important cases, with generalizations left to footnotes or appendices.
3282	979	G3	technical	clarification	19	19.4.2	19-20, 19-22		Not real clear. What they want to say is that if the true analyte concentration is zero or "background," then counts greater or equal to X_c will be observed with probability $(1-\alpha)$. The minimum detectable value X_d is that amount of analyte which will yield a measurement less than X_c with probability β or less. If this is right (I'm pretty sure it is), then these three pages are way too long.
3283	980	G3	technical	clarification	19	19.4.3	19-22	587-615	Do we really need to know about ISO versus IUPAC? This seems to beg for an appendix.
3284	981	G3	technical	suggestion	19	19.4.6	19-25	670	One good idea that deserves expansion is putting important points in bulleted form in boxes. The box on the top of page 19-25 is a good example. It is, however, critical that these boxed "important points" be as clear as possible. That is, the box on 19-25 states: "A measurement result should not be compared to the minimum detectable concentration to make an analyte detection decision. A detection decision may be made by comparing the gross signal, net signal, or measured analyte concentration to its corresponding critical value." This is an important recommendation that should be illustrated at this point by an example.
3285	982	G3	technical	clarification	19	19.5.2.2	19-31	810	Why is Equation 19.8 needed? If the distribution is uniform, a probability interval $(1-\alpha)$ is defined by $2a \times (1-\alpha)$.
3286	983	G3	technical	suggestion	19	19.5	19-33	847 ff	Equation (19.11) on page 19-33, for combined standard uncertainty, is only an approximation, not an equality. Admittedly, the text does state that "the variance of y is <i>estimated</i> using the [uncertainty propagation] formula" (emphasis added), but the presentation on this page does not clearly stress that the formula is an approximation, nor does it indicate the conditions under which this approximation would tend to be valid. In fact, both the use of an equal sign in Equation (19.11) and the use of terminology such as " <i>the</i> uncertainty propagation formula" or the " <i>law</i> of propagation of uncertainty" give the impression that the relationship in Equation (19.11) is an equality rather than an approximation. The report eventually clarifies the situation somewhat on page 19-38, where it states, "The formula is derived from a linear approximation of f (i.e., a first-order Taylor polynomial)." However, the report should state this whenever the formula is first introduced.

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	Row	Source	Category	Classification	Chap	Section	Page	Line	Comment
3287	984	G3	Technical	clarification	19	19.5.3	19-35	874	Looks like more appendix material. Would most users have a clue about the example? Moreover, is the resulting uncertainty useful? That is, is the result normal? If not what do we do with a variance or standard error?
3288	985	G3	technical	clarification	19	19.5.5.1	19-38, 19-39		Why? What are they trying to say? Is it important? Will anybody use it? What problem does it solve?
3289	986	G3	editorial	Organization	19	19.6.2	19-44	1040	It is important to get the most important material in at the start. For example, there is a nice discussion of counting statistics starting on page 19-44. This should be at or near the start of Chapter 19.
3290	987	G3	technical	clarification	19	19.6.2	19-46	1084 ff	If it is clearly Poisson with a low mean, the distribution is skewed; what's the point in estimating the standard deviation?
3291	988	G3	technical	clarification	19	19.6.5	19-52	1219	What do we mean by "counting efficiency"? I assume it is the number of particles detected over the number actually emitted, right?
3292	989	G3	technical	clarification	19	19.6.9	19-58, 19-59		On pipettes etc, how often is this material (the math) actually used?
3293	990	G3	editorial	suggestion	19	19D.2	19-121	2557	The example on Page 19-121 is an exact duplicate of the one on page 19-69, line 1634. Throughout the chapter, it would be helpful to number the examples to avoid duplication and facilitate reference in the text.
3294	991	G3	editorial	Organization	19	19E	19-135		Section 19E needs to be brought forward
3295	992	G3	technical	suggestion	19	19F	19-149		On a technical note, for normality testing the authors might want to look at: Looney, S.W. and T.R. Gullledge. 1985. Use of the Correlation Coefficient with Normal Probability Plots. American Statistician. 39: 75-79. This is an update of the earlier paper they discuss in goodness of fit testing.
3296	993	LA	technical	commentary	19	19	19-1		Most of the material on the subject of "measurement statistics" is contained in Chapter 19. This Chapter starts out with a very clear presentation, and with very clear recommendations and examples. However, the clear recommendations and examples fade later in the chapter, just when the material becomes more difficult and when clear recommendations and examples are needed.
3297	994	LA	technical	commentary	19	19	19-1		In some cases the material appears to be arcane and takes on the appearance of material written by a bunch of statisticians with no reality checks by persons who work in radiochemical laboratories. One of the things that strikes me as unchecked against reality is the indication that a correction for buoyancy is needed when weighing material on a laboratory scale. There are other examples of details included in the material that appear to be unrealistic in terms of having any real impact upon measurement uncertainty. At the same time other sources of uncertainty, especially those that cannot be defined ahead of time, are not treated well.
3298	995	SB	Technical	clarification	19	19	19		Lower case p is used for parameter, percentile, and probability at various points. Probably doesn't cause major confusion, but you could consider other choices.
3299	996	G3	technical	commentary	19	19	19		The general impression of our team was that the technical presentation, while statistically sound, might be too complex for the target audience of lab directors and staff. We have several suggestions that might help to make this chapter and several of the appendices more understandable to non-statisticians.
3300	997	G3	editorial	Organization	19	19	19		Overall the reviewers feel that there is too much material for one chapter in chapter 19. We suggest dividing the chapter into two sections, one on measurement, detection and quantification, the other on uncertainty evaluation and expression.

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	Row	Source	Category	Classification	Chap	Section	Page	Line	Comment
3301	998	LA	technical	commentary	19	19	All		Essentially all of Chapter 19 is devoted to the use of “a priori” data; further, the name Bayes is mentioned only once. It seems to me that, in reality, there can be many sources of uncertainty in analytical procedures that are not recognizable in advance and cannot be quantified using the material in Chapter 19. Thus, it is perhaps more realistic to use “a posteriori” data and Bayes Rule to derive realistic limits of minimum detection, etc. This has been the subject of recent literature; the absence of any information on this technique is a serious omission in MARLAP.
3302	999	G3	technical	suggestion	19	19C	19-105		Eliminate or revise attachment 19C on coverage factors. As currently written, it is doubtful that anyone without a Ph.D. in statistics with experience in laboratory uncertainty analysis could implement this methodology.
3303	1000	G3	technical	suggestion	19	19D	19-109		Revise attachment 19D to explain when someone should consider formulas A, B, and C, the Stapleton approximation, or the exact test. Does MARLAP have a preferred method? If so, it should be clearly stated, along with recommendations for situations when one of the other methods is preferable.
3304	1001	LA	technical	commentary	19	19D	19-109		Attachment 19D has a lot of interesting material on “Low-Background Detection Limits.” This is interesting, but there are many options given on how to calculate the detection limits, and no recommendations are given. This is a specific example of where recommendations would have been useful.
3305	1002	VB	Technical	suggestion	19	19.3.8	19-13	357-360	I am not entirely comfortable with the recommendation on page 19-13 that laboratories should report negative values when they are obtained, even if physically impossible. I understand the rationale for this, i.e., that laboratories should provide as much information as possible (to allow a complete evaluation), rather than censoring their results. However, reporting of physically impossible negative values can also be confusing. This is one of the advantages of Bayesian statistics, namely, with a non-negative prior distribution, one can ensure that the posterior distribution will take on only non-negative values. I do not have any strong ideas about how to solve this problem, since I realize that there are many obstacles to adoption of Bayesian analysis for these purposes, but just wanted to point out my discomfort. One way around the situation might be to recommend that labs report negative values when obtained, but clearly state that they are physically impossible, and provide guidance for how they sho
3306	1003	VB	technical	terminology	19	19.3.10	19-15	386-442	Much of the terminology for measurement uncertainty presented in Section 19.3.10 (e.g., "standard uncertainty," "expanded uncertainty," "coverage factor," "Type A," "Type B") seems non-standard and confusing to me. For example, "standard deviation" seems clearer than "standard uncertainty"; "upper and lower confidence limits" seems clearer to me than "expanded uncertainty" (which somehow gives the impression that the uncertainty has been exaggerated, or expanded beyond its actual measured extent!); and "subjectivist and classical statistical methods" seems clearer to me than "Type B and A evaluations." However, I recognize that the terminology used here may be standard in metrology, which is not my field

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	Row	Source	Category	Classification	Chap	Section	Page	Line	Comment
3307	1004	JM	technical	terminology	19	19.3.10	19-15	386-442	A simple figure or example accompanying this list of definitions would help the reader to understand the nuances among the different terms used for measurements, estimates, errors, and uncertainties. For example, describe the analysis for a soil sample associated with a site cleanup. Different types of measurements and estimates associated with the results could include the following: raw counts/minute (measurand and input estimate) and sample weight (measurand and input estimate), leading to a calculated sample activity in cpm/g (input quantity), and associated dose estimate (output quantity). A list of the potential errors associated with the dose estimate could include (a) counting error? (the definition on lines 391-392 is a bit ambiguous about whether or not this term is to be used), and (b) measurement error, which includes (b1) spurious error, due to (b1a) random error, (b1b) malfunction, or (b1c) similar types of events, as well as (b2) systematic errors. The example should include specific and real
3308	1005	VB	technical	suggestion	19	19.4.1	19-18	492-493	Page 19-18 states, "The significance level α is usually chosen to be 0.05." This is certainly a true statement, and if laboratories are going to choose a significance level on their own (e.g., because the customer for the test does not specify a significance level), that is the value I would want them to use. However, sophisticated users of laboratory services may occasionally want to specify another significance level, because of the relative importance of type I versus type II errors. For example, in some situations, it may be particularly important to detect contamination if it is present, in which case a user may be willing to accept a higher significance level than 0.05. The report should perhaps note that fact.
3309	1006	VB	technical	terminology	19	19.4.1	19-18	497-500	The report defines the term "blank" informally at the bottom of page 19-18, but it should also be included in the summary of terms related to detection and quantification capability in Section 19.4.7. The discussion may also need to be expanded and clarified, as the report uses a variety of terms, such as "blank signal," "instrument blank," "blank measurement," "blank material," "blank count," and the like. I had to figure some of them out from context, and the definitions may not always be clear to people who are not familiar with the terms. For example, some readers could misinterpret a "blank count" as referring to an observed count of zero (e.g., no radioactivity detected), rather than a count from a sample that contains none of the substance being analyzed (whether zero or not).
3310	1007	VB	technical	suggestion	19	19.5.2.1	19-30	790-797	On page 19-30, Section 19.5.2.1 discusses the computation of experimental covariance for evaluations of Type A. However, Section 19.5.2.2 contains no comparable discussion of covariance for Type B evaluations. I recognize that estimating covariance or correlation subjectively is an extremely difficult task. However, if correlation is important enough to be worth discussing for evaluations of Type A, it is presumably also important for Type B evaluations. One good reference on the subject is "Assessing Dependence: Some Experimental Results," by R. Clemen, R. Winkler, and G. Fischer, Management Science, 46 (2000), 1100-1115.
3311	1008	VB	technical	suggestion	19	19.5.3	19-33	848-856	Equation (19.11) on page 19-33, for combined standard uncertainty, is only an approximation, not equality. The report eventually admits this on page 19-38, which says, "The formula is derived from a linear approximation of f (i.e., a first-order Taylor polynomial)." Therefore, it is exact only for simple additive functions (or for multiplicative functions when the factors are independent). In other cases, the analyst would need to know the entire distribution of the input variables (not merely their standard deviations) to find the standard deviation of the result. When the first-order Taylor polynomial is not sufficiently accurate, analysts can use Monte Carlo simulation to propagate uncertainty. The report should probably note this (at least in a footnote), preferably with one or more references. Admittedly, when uncertainties are small, the errors associated with the first-order Taylor polynomial are likely to be small. However, the report should clearly state that the formula is an approximation wh

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	Row	Source	Category	Classification	Chap	Section	Page	Line	Comment
3312	1009	G3	technical	commentary	19	19.5	All		The discussion of uncertainty propagation in subsections 19.5.3 (Combined Standard Uncertainty), 19.5.5.1 (uncertainty propagation for nonlinear models), and 19.5.5.2 (Bias) is both incomplete and potentially misleading. In particular, the methods presented are only approximate, but this is not always clearly stated. The report also does not give references to approaches that would be more generally applicable when the approximate methods presented here are not appropriate.
3313	1010	G3	technical	suggestion	19	19.5	All		Similar problems of notation (presenting approximations as equalities) appear throughout Section 19. Admittedly, when uncertainties are small, the errors associated with the first-order Taylor polynomial are likely to be small. However, the report should clearly state that the formula is an approximation when it is first introduced, and misleading notation and terminology (such as referring to the formula as the "law of propagation of uncertainty") should be avoided if possible.
3314	1011	G3	editorial	terminology	19	19.5.3	19-34		It would also be helpful if the terminology and notation clearly indicated (both in these subsections and throughout Section 19) the approximate nature of most of the calculations. To give an indication of the nature of the problem, consider Table 19.1, which presents applications of the uncertainty propagation formula to various mathematical expressions. The table shows all of the results as equalities, even though the uncertainty propagation formula is only approximate for all applications shown in the table except to sums and difference. By contrast, in the last row, the table uses an "approximately equal" sign to indicate that $(\ln 10)^2$ is only <i>approximately</i> equal to 5.302. This latter result is at least accurate to four significant figures, while in some cases, the results presented as equalities might not be accurate to even a <i>single</i> significant figure!
3315	1012	VB	technical	suggestion	19	19.5	19-35	783-1023	I agree with Rick Hornung's observation that in the examples presented here, "the uncertainties for each of the input parameters ... are already provided." In my view, this is a serious shortcoming. Methods for subjectivist (i.e., Type B) evaluations of uncertainty are a whole subfield of Bayesian statistics and decision analysis; I can provide some references on request.
3316	1013	VB	technical	suggestion	19	19.5	19-35	783-1023	As pointed out by Rick, the examples in this section also all involve extremely small uncertainties. These may well be representative of the uncertainties arising from lab work, but that is not clear, and someone knowledgeable about radiological laboratory measurement should assess the reasonableness of the uncertainty estimates used in the examples. My own personal suspicion is that while statistical uncertainties (e.g., variability between replications of the same measurement) may tend to be small, that will not always be the case (e.g., with poor laboratory procedure). More significantly, I would expect that systematic error (or "bias" -- for example, due to use of inappropriate laboratory methods, contamination of samples, etc.) would tend to be much larger than statistical variability, and probably larger than the uncertainties given in many of the examples in this section.
3317	1014	VB	technical	suggestion	19	19.5.3	19-35	874-904	Similar to the case for Equation 19.11, the example on page 19-35 appears to compute the output estimate A as a function of the mean values of the various input parameters. Again, this is an approximation based on a first-order Taylor polynomial. In fact, assuming that the mean of a function is equal to the function of the mean is one of the most common and most serious fallacies of novices in probability. This is acknowledged only several pages later (on page 19-40), and in a rather roundabout way (i.e., "If f is nonlinear, its nonlinearity may also tend to bias the output estimate y"). This vague explanation may help to account for Bobby Scott's confusion about the use of the term "bias" on page 19-41. As before, the report should clearly state that the formula is an approximation when it is first introduced, and I would recommend using an "approximately equal" sign instead of an equality sign here (and throughout the report, when presenting approximations).

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3318	1015	G3	technical	commentary	19	19.5	All		Experience in situations where the uncertainties are substantial has made some committee members leery of first order error propagation. When uncertainties are large and it is important to have a good estimate of their magnitude, it is preferable in our view to develop a good description of the process generating the uncertainty and the error distributions involved, and then do a Monte Carlo analysis. In Section 19.5.5.1, the report does show how to include higher-order terms in the uncertainty propagation formula. However, the version of the uncertainty propagation formula presented in this subsection assumes that "all the input estimates $x_{\text{sub } i}$ are uncorrelated," and no mention is made of Monte Carlo simulation as an alternative to the uncertainty propagation formula when uncertainties are substantial and the approximations given here are not valid.
3319	1016	G3	technical	commentary	19	19.5.5	All		Even a second order Taylor polynomial can be inaccurate when uncertainties are large and the function of interest exhibits significant nonlinearities. In such cases, the analyst needs to know the entire distribution of the input variables (not merely their marginal variances) to find the variance of the result. Analysts can use Monte Carlo simulation to propagate uncertainty in such cases, and in principle can achieve any desired level of accuracy by increasing the number of simulation replications. The report should note this (at least in a footnote or an appendix), and should provide one or more references. In fact, the discussion of second order Taylor polynomials could also go in an appendix, and in any case second order Taylor polynomials should not be featured more prominently in the discussion of uncertainty analysis than Monte Carlo simulation.
3320	1017	G3	technical	suggestion	19	19.5.5.2	All		Section 19.5.5.2 claims to be a discussion of bias. However, this section does not seem to be using the term in the usual statistical sense, as discussed on pages 19-5 and 19-6, but rather refers to the potential inaccuracy of the Taylor polynomial approximation. Moreover, the estimate of bias given by Equation (19.18) appears to be itself a Taylor polynomial approximation. Rather than providing an estimate of the bias from use of the Taylor polynomial, the committee would prefer a qualitative discussion of situations in which this approximation is not accurate (e.g., when the uncertainties span a range sufficiently large that the function of interest is not approximately linear over that range). The report should also recommend the use of Monte Carlo simulation in such cases.
3321	1018	G3	technical	suggestion	19	19B	19-97		Appendix 19B should be eliminated.
3322	1019	LA	technical	commentary	19	19B	19-97		It seems to me that some of the potentially most useful information relates to the use of vectors and matrices to examine larger bodies of data and to use least-squares approaches. However, this material is not well developed; specifically, a good example of these techniques should be given.
3323	1020	GR	Editorial	Grammar	20	20.2	20-1	26	multiservice
3324	1021	GR	Editorial	Grammar	20	20.2	20-1	28	nonradioactive
3325	1022	GR	technical	clarification	20	20	All		Should a reference be made as to where the CFRs are to be found?
3326	1023	GR	editorial	commentary	20	20	All		I am impressed with the Chapter. However, I must add that I am not an expert in Waste Management. The Chapter has good flow. The second paragraph in the introduction is a nice road map that tells what the Chapter is all about. The Chapter, out of necessity, gives general guidelines and then lists specific references to lead readers to areas for more detailed information.
3327	1024	GR	editorial	commentary	20	20	All		Good flow, well written etc

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3328	1025	GR	editorial	suggestion	20	20	All		Hyphens. The new rule with regard to hyphens is to use fewer of them, especially on "non" words. Therefore, I recommend taking out the hyphens of the following words: nonradioactive (lines 28, 92, 93, 97, 145, 152, 153), multiservice (line 26), degreasers (Table 20.1, row 3), biphenyls (Table 20.1, row 14), nonhazardous (lines 123, 137), microscale (line 130), reuse (line 140)
3329	1026	GR	Editorial	Grammar	20	20.2	20-2	Table 20.1	row three, degreasers; row 14, biphenyls
3330	1027	GR	Editorial	Grammar	20	20.4	20-4	92	nonradioactive
3331	1028	GR	Editorial	Grammar	20	20.4	20-4	93	nonradioactive
3332	1029	GR	Editorial	Grammar	20	20.4	20-4	97	nonradioactive
3333	1030	GR	Editorial	Grammar	20	20.4	20-5	123	nonhazardous
3334	1031	GR	Editorial	Grammar	20	20.4	20-5	130	microscale
3335	1032	GR	Editorial	Grammar	20	20.4	20-6	137	nonhazardous
3336	1033	GR	Editorial	Grammar	20	20.4	20-6	140	reuse
3337	1034	GR	Editorial	Grammar	20	20.4	20-6	145	nonradioactive
3338	1035	GR	Editorial	Grammar	20	20.4	20-6	152	nonradioactive
3339	1036	GR	Editorial	Grammar	20	20.4	20-6	153	nonradioactive
3340	1037	GR	editorial	clarification	20	20.6	20-7	180	should AEA be written out?
3341	1038	GR	editorial	clarification	20	20.6.1	20-10	275	should this be rewritten since October 2001 has passed?
3342	1039	SB	technical	clarification	20	20.6.2.4	20-12	337	Think you mean "airborne radioactivity", not "radiation".
3343	1040	SB	editorial	typo	20	20.7.1	20-14	393	Somehow what was supposed to be a comma came out "B".
3344	1041	GR	editorial	commentary	20	20.8	19-16	451	The section, 20.8, Useful Web Sites, is an excellent addition to the Chapter. (However, just before final publication someone should check all of them to be sure they are all correct and active.).
3345	1042	GR	editorial	suggestion	20	20.8	20-16	451	Change title of Marlap to RAP section for useful; websites.
3346	1043	JM	editorial	Format	A - F		All		The appendices are inconsistent in how sections are numbered: e.g., A.12.6, D2.6
3347	1044	JJ	editorial	clarification	All		All		Some of the tables are cut in the middle because of placement on the page. Presumably this will be addressed in the final version of the document.
3348	1045	G1	editorial	commentary	All		All		Text in some of the flow charts is too small in many cases and unreadable in a few cases
3349	1046	GB	technical	commentary	All		All		There is not adequate advice to laboratories on how they check their own data Chapter 7.3 and 7.4 and tie in Chapter 17 with Chapter 8, 9. Consumer advice is present on how to verify and validate data, but no parallel advice to labs on how to check their own data. Verification is possible but not validation. What advice do we give to the lab to verify data? Set up Quality Assurance and/or Quality Control and reporting format criteria. Page 17.39 talks about data packages.
3350	1047	SB	technical	Suggestion	All		All		Another potential problem is that many of the manual's chapters are written as if directed toward project managers in the sponsoring organization, while others are written as if directed toward the laboratory personnel, cautioning them about mistakes the sponsors could make (e.g., Chapter 11).
3351	1048	G1	editorial	suggestion	All		All		The document would benefit from an index
3352	1049	G1	editorial	suggestion	All		All		Use of traditional units in parentheses is uneven - RAC should decide to recommend this practice, or not, and then suggest that use or no-use be applied uniformly

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3353	1050	G2	editorial	format	All		All		Use the same reference format throughout the text.
3354	1051		technical	suggestion	All		All		Sometimes text is too specific and as the information is often not complete anyway, and it is stated in the MARLAP document that the intention is not to provide guidance in sampling, there should be some rewrite.
3355	1052	SI	editorial	suggestion	All		All		The arrow symbol (--->) throughout the entire report is too small in size.
3356	1053	TG	Editorial	Terminology	All	11	11		Throughout the document, the words radioactivity or isotope(s) are used when radionuclide(s) is the appropriate term.
3357	1054	SB	technical	suggestion	B	B3.1	B-4	96	The recommendation to show a "site conceptual model" presumes that the decision relates to the remediation of a site, which isn't always the case. Maybe add "and appropriate" after "possible". Also, at the end of this subsection it might be useful to add an example "concise description".
3358	1055	SB	editorial	typo	B	B3.2	B-5	125	Comma after (TEDE) should be a semicolon.
3359	1056	SB	editorial	suggestion	B	B3.3	B-6	155	Remove "compatible" or "in complete agreement".
3360	1057	SB	technical	clarification	B	B3.6	B-9	247	"exits" should be "exist". Also, I would prefer a more concrete example of the decision rule.
3361	1058	SB	editorial	suggestion	B	B3.7	B-9	258	Might follow this sentence with a cross reference to B-1.4, where the choice of the null hypothesis is discussed.
3362	1059	SB	technical	clarification	B	B3.7	B-10	298-299	Is it an "action limit" or "action level"?
3363	1060	SB	editorial	suggestion	B	B3.7	B-11	306	Suggest inserting "is understood as" before "making".
3364	1061	SB	technical	commentary	B	B-1.4	B-18	507-508	I don't see why the project planning team is more likely to discover a mistake in a high reading than a low one if they are indeed wedded to a null hypothesis that contamination exists.
3365	1062	SB	technical	suggestion	B	B-1.6	B-21	606	It is easy to read this section as saying that one defines the gray region in terms of the MDC. I think it is really the other way around, as suggested in Appendix C: One uses the decision parameters to define the gray region and then calculate what MDC is needed to support it. Maybe a cross reference to Appendix C here.
3366	1063	SB	technical	clarification	C	C.3	C-4	97	It was not entirely clear to me whether the sigma squared sub s here is the variance of the distribution or the variance on the mean of the distribution. I suspect that it is the latter because the decision regards the sample mean. In any event, some clarification is in order.
3367	1064	SB	technical	clarification	C	C.3	C-4	110	It is not clear to me that one CAN control sigma sub s. The statement would still be true, but is "easier" the right word? What did the writer have in mind?
3368	1065	SB	technical	clarification	D	D2.7.1	D-13	366	According to your convention, shouldn't "false positive" be "Type II error"?
3369	1066	G2	editorial	commentary	F	F	All		This appendix is thought-provoking and is a step toward quantifying uncertainty in sub-sampling, despite the disclaimers.
3370	1067	G2	editorial	suggestion	F	F.3.2	F-6	152-159	Sections of Chapter 12 , which have more detailed descriptions of equipment used to mix and grind solid samples and methods for decontamination should be cross-referenced from here.
3371	1068	G1	editorial	suggestion	G	G	G-1		The table of contents indicates that a glossary will be provided. As this is being done, it may be useful to place in bold font, terms in each definition that are further defined in the glossary.
3372	1069	BB	technical	commentary	Part I		All		The boxed Summaries of Recommendations seemed useful and easy to understand. However, it was not clear to me whether there were too few of them relative to the large amount of detail given in each chapter.

APPENDIX C. Compilation of MARLAP Panel Review Comments

	Row	Source	Category	Classification	Chap	Section	Page	Line	Comment
3373	1070	SB	editorial	commentary	Part II		All		Overall, Chapters 10-18 and 20 and the associated appendixes represent an enormous effort and supply a vast amount of information on radioanalytic laboratory procedures in support of environmental health decisions. No important area of concern appears to me to have been overlooked. The advice given is well supported by extensive citations to the scientific literature and bibliographic compilations of related documents and sources. The chapters are generally well organized and the exposition is generally clear; typographic and grammatical errors are minimal. Whatever concerns I have about these chapters tend to be minor, and I consider none to be fatal.
3374	1071	SB	editorial	commentary	Part II		All		I am somewhat concerned that some of the chapters may not be as usable and user-friendly as others. Contrast, for example, Chapter 18 on Laboratory Quality Control with Chapters 13-15 on the details of laboratory procedures. Chapter 18 is quite specific in its advice for maintaining quality through performance indicators, and maintains a consistent format for describing each indicator. Chapters 13-15, especially 15, tend to be more encyclopedic and descriptive, without as much clearcut advice. Although I understand that the MARLAP team deliberately avoided making specific recommendations for choice of analytic procedure, a choice that I support, I wonder whether a laboratory tasked with analyzing a specific set of samples will easily find the information it needs in these comprehensive chapters. Perhaps what is needed is a section on "how to use this document" where a laboratory would find directions on how to find the critical information for its needs. For example, if it receives samples of soil thought to
3375	1072	JJ	technical	commentary	Part II		All		Many of the references to analytical methods appear to be old (1950s and 1960s). They may be valid and the best available information but it seems odd that there is not more recent information.
3376	1073	G2	technical	suggestion	Part II		All		We suggest that Part II be divided into two volumes to facilitate convenient use in the laboratory. A reasonable separation may be between chapters 10 – 14 plus 20 and 15 – 19. The former chapters pertain mostly to chemistry and the latter, to radiation detection.
3377	1074	G2	technical	suggestion	Part II		All		We suggest that the format for reporting environmental radionuclide data should depend on the end use of the data and the necessary transmission of information to the reader. Specifically, care should be taken in reporting radionuclide concentrations that are negative due to subtracting the radionuclide background, or are below the level of detection as determined from counting statistics. Such numbers should be reported for subsequent use in compiling or averaging the data, or for evaluating the reliability of measurements near the limits of detection. For use in describing environmental contamination to the public, the facility operator, and regulators, such numbers should be replaced by "less-than" values or a statement of non-detectability.
3378	1075	G2	editorial	Organization	Part II		All		Cite the original reference for a method as the method is discussed instead of combining all references at the end of the subsection.
3379	1076	LA	technical	commentary	Part II		All		With respect to Charge Question # 3: As nearly as I can tell, the material is technically accurate. However, I think the material could be more clearly and usefully presented. Lacking a more clear presentation, I doubt that "appropriately trained personnel" can implement much of the material.
3380	1077	LA	technical	commentary	Part II		all		Another aspect that I believe to be very important is that of establishing criteria for the rejection of analytical results when samples are processed as batches. That is, criteria for when the entire batch of results should be rejected based upon information for quality control samples and blanks processed with a particular batch. This is a very important subject for contracting (Appendix E) and for laboratories themselves when processing batches of samples for, for example, the analysis of 239,240Pu. I think this subject should be dealt with much more extensively.